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Global Value Chains: Impacts and Implications

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Aaron Sydor
Editor

Disclaimer

Foreign Affairs and International Trade Canada managed and assembled this volume of research with the objective of contributing to our understanding of and encouraging further work on global value chains (GVCs), an important issue that will continue to impact the international business environment. The views expressed in this volume, however, are those of the authors and do not necessarily reflect the views of organizations represented, Foreign Affairs and International Trade Canada or the Government of Canada.

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Foreword

This special edition of Trade Policy Research explores the subject of Global Value Chains (GVCs). The rise and evolution of GVCs is an issue of importance to Foreign Affairs and International Trade Canada. GVCs were featured prominently in the Government's Global Commerce Strategy along with the related issues of growing international competition and the growth of emerging economies. Indeed, the concept of global value chains was a key driver of the Department's focus on international commerce, which acknowledges the increasing importance of and linkages between exports, imports, trade in services, and flows of investment and technology.

Foreign Affairs and International Trade Canada is committed to undertaking policy analysis and research to better inform and guide the Department's decision making process. Sharing that work, as well as the Department's policy research interests, with the wider policy-research community is also an important objective of which the Trade Policy Research series is an important component.

It is my hope that the policy research community will benefit from the studies contained in this volume and that together we will continue work on this important topic.

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Ottawa
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Global Value Chains: Impacts and Implications
Editor's Overview

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Introduction

It is increasingly rare that a good or a service is entirely produced at one location and then exported to a final consumer. Rather, production of a good or even service involves an increasingly complex process with intermediate inputs and supporting activities sourced globally from wherever it is most efficient to do so. These complex international production arrangements have come to be known as global value chains (GVCs), a commonly cited definition of which is the following:

> *A global value chain describes the full range of activities undertaken to bring a product or service from its conception to its end use and how these activities are distributed over geographic space and across international borders.*[1]

Although difficult to measure, there is a growing body of evidence supporting the growing importance of GVCs. One of the most compelling pieces of evidence is that the ratio of trade to world GDP expanded from about 16 percent in 1990 to 27 percent in 2008, the year before the global financial crisis fully impacted global trade. With the onset of the global financial crisis, trade as a share of GDP fell to 22 percent in 2009 and has since rebounded to just over 24 percent as of the close of 2010.[2] Sturgeon and Gereffi (2009) show that increased trade in intermediate inputs, resulting from the global fragmentation of production, accounts for a considerable share of that growth.[3] More rigorous measures have also been developed and show similar trends, such as indexes of vertical specialization developed by Hummels, Ishii and Yi (2001) and Yi (2003).

Multinationals (MNEs) play an important role in the development of GVCs through their decisions about where to source, what suppliers to use and what they will produce themselves. Statistics on the growing importance and scope of MNEs further supports the rise of GVCs. Between 1990 and 2008, total sales by MNEs increased form US$6 trillion to more than US$31 trillion – a roughly five-fold increase. Total assets increased by even more, rising by 1100% to nearly US$72 trillion in 2008 while employment reached almost

[1] Adapted from the definition of global value chains used by GVC Initiative at Duke University http://www.globalvaluechains.org/

[2] Authors calculations based on data from the International Monetary Fund (IMF) and World Trade Organization (WTO). Reported as the ratio of imports to GDP.

[3] Although trade in intermediate inputs accounts for a large share of growth in global trade, by a number of measures, its share has not increased. Sturgeon and Memedovic (2011) attribute this to a misclassification of certain goods and show that under an updating of the classification system, intermediate inputs indeed grow more quickly the total trade.

79 million.[4] It is estimated that the 500 largest multinationals now account for nearly 70 percent of global trade.[5]

The rapid growth and enormous scale of these figures illustrate the extent to which GVCs and multinationals have expanded over the past two decades. But, multinationals are not the entire story. They fail to capture all of the purchases, both domestic and local that are made as part of GVCs. Firms of all sizes, including small and medium sized firms (SMEs), are linked to global value chains as suppliers and customers, and in many instances will lead GVCs on their own.

GVCs During and After the Crisis

Although GVCs have been steadily gaining traction in policy and academic circles, they have achieved a new importance during and following the global financial crisis.[6] Global value chains (GVCs) appear to have played an important role in the recent global economic crisis; they likely magnified the impacts of the crisis on trade flows, spread the impacts more quickly and among a greater number of countries but may have also moderated the impact of the crisis.

Although the global financial crisis initially started in the financial and housing sectors and in a limited number of countries, it quickly transformed into a global crisis. A significant amount of that spread was through the linkages within the financial sector and there are likely other conduits through which the crisis spread such as through impacts on consumer confidence and by acting as a demonstration effect.[7] But, there is little doubt that linkages between countries through GVCs also contributed to the spread. As demand in the U.S. shrank, for example, production in China was reduced which was transmitted throughout the value chain reducing production in supplier countries as well. As a result, the collapse in global trade was far more severe than was expected and far greater than the fall in global GDP. This too can partially be explained by other factors such as the disproportionate impact of the crisis on demand for goods, which are more heavily traded, and even on export financing. But, there is considerable evidence that the coordination and extent of the collapse in world trade had a lot to do with GVCs.[8] On the positive side, however, there is also evidence that by spreading the pain, the existence of GVCs reduced the overall impact of the crisis.[9]

Following the crisis, GVCs continue to garner attention. Pascal Lamy, Director-General for the World Trade Organization (WTO), has recently emphasized on a number of occasions the importance of global value chains and the need to develop value-added measures of world trade. In this vein, the WTO has recently launched the "Made in the

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[4] A figures from UNCTAD's World Investment Report 2010.

[5] World Trade Organization, http://www.gatt.org/trastat_e.html

[6] Within the economic literature, the term "global value chain" is rarely used. However, we are treating the various languages of offshoring, outsourcing, trade in tasks and others all as falling within the rubric of GVCs.

[7] The bursting of the housing bubble in the U.S., for example, may have brought attention to and caused similar bubbles to burst in other countries.

[8] See, for example, Escaith, Lindenberg and Miroudot (2010), Cheung and Guichard (2009), and Bems, Johnson and Yi (2009)

[9] See, for example, Freund (2009) and Conference Board of Canada (2010).

World" initiative to develop approaches in measuring and analyzing trade in value-added.[10] The World Bank, WTO, and OECD have all recently held conferences on global value chains and many are developing work plans to address some of the main issues raised.

The WTO in particular has a very focused interest in GVCs relating to the calculation of value-added trade. With the rise of GVCs, trade flows, which are expressed on a gross basis, may become increasingly inflated as a product is counted multiple times when it crosses a border as part and again as a final product. This can have the effect of multiplying the impact on trade flows of changes in demand as was observed during the financial crisis. It also has the impact of making trade appear to be more important than it actually is and on the distribution of bilateral trade flows and bilateral balances – although importantly, not on overall trade balances. It is therefore hoped that by developing a value-added measure of trade, that this will allow countries to have a better understanding of the "true" trade linkages between countries as well as producing a more accurate representation of the role of trade for national economies. Having a value-added measure of trade could also be used to produce a more accurate assessment the impact of exchange rate movements on bilateral trade flows, an issue of current importance given concerns over global imbalances.[11]

How GVCs Fit Into Economic Theory

Since David Ricardo expressed his views in 1817, international trade theory has been governed by a belief in comparative advantage which loosely states that each participant in trade will specialize in producing that good in which it has comparative advantage. Comparative advantage under Ricardo is simply measured as a cost advantage, without being explicit as to the source of the advantage, although is generally interpreted and modeled as a difference in technology or geography. Heckscher and Ohlin built on this foundation arguing that differences in factor endowments determine differences in relative costs. This produces, for example, the now well-known result that labour intensive countries should specialize in producing labour-intensive products and capital-intensive countries in capital intensive products.

In these classical models it is recognized that firms or even individuals trade, but that differences in technology (as in Ricardo's example) or endowments (as in the H-O model) are specific to different locations, usually assumed to be countries. Under the so called "new trade theory" developed by Paul Krugman in the 1980s it is no longer only the differences that matter. Even countries that are similar will engage in and benefit from trade if each specializes and as a result becomes more efficient in production. Again, it is firms or individuals that trade, but the potential gains from specialization are characteristics of the industry.

An additional element of the new trade theory is the importance of geography. In order to minimize transportation costs, firms will have a preference to locate close to customers as well as to suppliers. Those firms that can lower costs in this way gain an advantage over competitors. Large population centers thus become a magnet for production, which is self reinforcing as upstream and downstream activities follow and

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[10] See http://www.wto.org/english/res_e/statis_e/miwi_e/miwi_e.htm

[11] See, for example, the presentation by Kei-Mu Yi, Senior Vice President and Director of Research, Federal Reserve Bank of Minneapolis.
http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/TRADE/0,,contentMDK:22894003~menuPK:2644066~pagePK:64020865~piPK:51164185~theSitePK:239071,00.html

industrial clusters emerge. But, once again, the differences in transportation costs and the relative importance of being close to suppliers and to customers, also known as agglomeration effects, are characteristics associated with the industry.

If classical theory focuses on differences in characteristics between locations, and new trade theory focuses on the characteristics of individual industries, more recently, heterogeneous firm theory, which is often called new new trade theory, focuses on the characteristics of individual firms. New new trade theory recognizes that within a given industry and in a given location there can be a great degree of variation between firms. There will be many firms that do not engage in international trade, those that do tend to be more productive and the subset of those that both trade and invest abroad tend to be even more productive.

Within new new trade theory, opening to international trade allows for the best firms to expand and replace weaker firms resulting in increased productivity, higher wages and improved standards of living. Under both classical and new trade theory, much of the gains from trade occur as a result of the movement of resources between industries[12], under new new trade theory much of the benefits from trade occur as a result of the shifts within industries. Additionally, under new new trade theory, trade takes place as a result of the differences between individual firms that possess a technology (i.e. process, product, or management) or intellectual property (IP) that makes them better able to compete internationally. This produces a second source of benefit from exchange in that as individual firms expand, they can spread fixed costs of innovation across a larger customer base, increasing the incentives to innovate. As a dynamic benefit that accumulates over time, much like compound interest, this potentially is a critical gain from trade.

Just as trade theory has developed to identify a number of drivers at various levels of disaggregation (i.e. country, industry and firm), the theory of FDI is also focused through multiple lenses. The most commonly used theory of FDI is known as the "Eclectic Theory of FDI" precisely because of its multiple drivers, indeed it is often simply referred to as the "OLI" theory because it is a mix of three theories; Ownership advantage, Location advantage, and Internalization advantage. *Ownership advantage* is, in a sense, similar to heterogeneous firm trade theory in that it focuses on specific firm-level advantages such as technology or management practices. A multinational can expand internationally and enter new markets because it is employing better technology, superior management practices or similar firm-specific advantages compared to rivals. Economies of scale, as described in new trade theory may also be though of as belonging in this category as they are realized at the firm level. However, while new new trade theory explains why some firms might export and others do not, ownership advantage explains why a foreign multinational will invest in a foreign location and succeed against domestic firms which would otherwise be expected to have an advantage in their own market. *Location advantage*, on the other hand, relies on the firm having an advantage that derives from the home location of the firm. Location advantage also impacts on where the firm will locate activities. In this sense, the location advantage theory is comparable to classical theories of trade with comparative advantage. *Internalization* relies on a transaction cost model of the firm extended to the multinational by McManus (1972). Essentially, a multinational must decide whether to serve a local market through an arrangement such as licensing or franchising (i.e. outside of the ownership structure of the firm) or to serve the

[12] Gains from trade in these models can be a result of reduced costs from economies of scale or more efficient use of resources as well as from reducing distortions as one moves closer to perfect competition and from increased product variety.

market by investing. An important factor in making this decision will be how difficult it is to undertake a contract. In a jurisdiction with strong private property rights and enforcement mechanisms as well as developed markets for the goods or services to be contracted for, then it is more likely that the firm will be willing to undertake a contractual agreement such as licensing or franchising. However, if the opposite is the case, then the firm will desire to keep those activities within the firm.

The concept of global value chains fits into and builds on this evolution of our understanding of why and how trade and FDI occurs. Feenstra and Hanson (1996, 1997), for example, begin with a Heckscher-Ohlin type model but divide the production process for any particular final good or service into activities. These activities can then be allocated to the location where they are most efficiently performed. Grossman and Rossi-Hansberg (2008) provide a similar model for trade but instead of activities focus on tasks. The difference between activities and tasks is in a sense an issue of aggregation. Where an activity may be legal services, for example, that activity may be broken into separate tasks such as the high valued legal advice and the more routine aspects such as filling out paperwork.[13] The implication being that, more routine tasks can be performed in a low-skilled environment while higher-valued tasks will be performed in a high-skilled environment. One implication being that it becomes more difficult to predict who will bear the impact of globalization. In the past an industry or an occupation could be thought of as being impacted by trade. Within a trade in tasks environment what matters is how routine tasks are, how they are delivered and if they can be codified. An additional difference between the two models is the role of the firm. The Feenstra and Hanson model, although not explicitly stated, could potentially be interpreted as describing arms-length transactions as there is assumed to be a technology difference between home and host country (i.e. outsourcing). In the Grossman and Rossi-Hansberg model, it is possible to interpret the model as describing transactions as being internal to the firm as technology levels are the same between the two locations (ie. offshoring). Even so, these models do not explicitly consider the role of the multinational enterprise. There is no clear decision to offshore (invest) or outsource (contract). Antras (2003, 2005) takes an important step in forming that link between trade and investment theory by enhancing our understanding of how firms make the decisions where to locate various activities and whether or not to exert direct control (i.e. the decision to perform the activity within the firm or to source it from outside the firm). Clearly though, more work is still required to solidify the link between theories of trade and FDI that is critical to the operation of global value chains.

This volume attempts to further elaborate on the link between trade theory, firm location and GVCs with the practical focus of understanding if the gains predicted by trade theory still hold in the presence of GVCs. The volume also explores the drivers of the growth in GVCs, trends in Canada as well as other countries, it looks at some key "high valued" sectors and ends with an examination of some the potential policy implications.

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[13] The difference between tasks and activities is important but beyond the scope of this article. The more generic term "activities" will be used throughout the article but is not expressing a preference for one over the other.

Theory

The first section of the volume further explores the relationship between global value chains and trade theory. Steven Globerman in his chapter "Global Value Chains: Economic and Policy Issues", reviews the theoretical underpinnings of international trade and firm location. He does not see a need for a new theory to explain GVCs as they can be fit into existing trade theory. Globerman suggests that GVCs in essence are trade at a more granular level and increasingly in services, but would be driven by the same factors that we have come to understand under standard trade theory and as outlined in the previous section - including comparative advantage. As such we would also expect trade under GVCs to produce the same benefits that would be expected from any international exchange but by trading at a finer level and extending trade to include more services should result in additional gains from trade.

Following this line of argumentation, that GVCs do not need a new theory, Globerman argues that it is then also unlikely that there are significant impacts for policy, at least overall. Improvements to infrastructure, investments in R&D and education, and reducing barriers to trade would all be beneficial under GVCs, just as they would with traditional trade. However, he does note that the greater level of competition at a finer level might strengthen the case for such policy actions and require policy to become more granular as well.

In his paper "Integration of the North American Economy and New-paradigm Globalization" Richard Baldwin analyzes the potential implications of the rise of GVCs using a new trade theory framework. This compliments the aforementioned models developed by Feenstra and Hanson (1996, 1997) and Grossman and Rossi-Hansberg (2008) which are based on the classical models of trade. New trade theory is Baldwin's model of choice as it allows for analysis of the distribution of activity within North America[14] which can be characterised as a core (the U.S.) and periphery (Canada) rather than high-wage location and low-wage location as in the classical trade models. In this framework, the rise of GVCs is seen as changing the balance of forces that determine the geographical distribution of economic activity; toward the forces of dispersion and away from those of agglomeration. To put this in another way, the increased ease of coordinating activities across space and reduced costs of communication, that are thought to be behind the growth of GVCs, reduce the benefit of clustering activities (such as in the larger U.S. market) thus allowing them to become more disperse and to take better advantage of geographical differences such as in wages.

Baldwin finds that this "new paradigm globalization" has a number of important implications. Firstly, and consistent with the Rossi-Hansberg trade in tasks model, it becomes more difficult to predict who will be the winners and losers from globalization. This has implications for the ability of the winners of globalization to be able to compensate the losers and generally increases uncertainty for workers. These, in-turn, increase the difficulty for governments to prepare their populations for globalization such as through training as well for building the support for trade policy. A second impact is that as production becomes more mobile, policy differences between jurisdictions can have a greater impact. Baldwin calls this the "multiplier effect" and is similar to Globerman's finding that competition takes place at a more granular level. Within a North American context, this multiplier would be expected to magnify positive (negative)

[14] North America here refers specifically to Canada and the United State of America

impacts of changes that make the Canada-U.S. border more (less) transparent for trade flows.

Most discussions of global value chains begin by claiming that GVCs have grown in importance as a result of lower transportation costs, improvements to information and communications technologies (ITCs) or similar innovations. To date, however, there has not been any systematic evaluation of these claims. In his chapter "Causes of International Production Fragmentation: Some Evidence", Russell Hillberry attempts to shed some light on this gap. Hillberry first evaluates the role of ICTs by looking at one specific formulation where ICTs are compliments to the use of imported intermediate inputs. He, however, fails to find a linkage between use of ICTs and growth in use of imported intermediate inputs. He next evaluates whether the introduction of new players into the global trading system contributed to the growth of GVCs. He does find some evidence that the opening of former communist countries did play a role in the growth of GVCs and hypothesizes that it may have been these countries' unique combination of strong technical skills and low wages that lent themselves to producing technically complicated intermediate inputs. However, he also finds that these effects had largely run their course by 1996. Lastly, Hillberry examines the role of transportation modes. He shows that while containerized shipping may often be cited as a driver of the growth in GVCs, air transport may have actually been more important. It is important to keep in mind though that the quality of the data available to evaluate these various drivers is rather limited and thus any conclusions should be viewed with an appropriate level of caution. If policy makers are to better understand whether GVCs will continue to grow in importance, stagnate or even decline, it will be important to understand what drove their development. Further work in this direction would contribute to a better understanding of the forces at play.

Evidence

Measurement has probably been the most significant obstacle to developing a better understanding global value chains. It is nearly impossibly to predict the impact of, or to design policy to influence, something that cannot be measured. A great deal of progress has been made in recent years to obtain better measures of global value chains. The chapters in this section take a variety of approaches to obtain better measures of global value chains in general or of specific aspects of GVCs.

The first chapter in this section, "International Comparative Evidence on Global Value Chains" by Koen De Backer and Norihiko Yamano provides a cross-country perspective of global value chains largely utilizing a recently developed comparable database of input-output tables for OECD and select other countries. Their data confirms the growing importance of GVCs as defined by the rising share of imported intermediate inputs compared to domestically sourced inputs for nearly all countries in their sample. The rising importance of GVCs is also seen in the author's calculation of a vertical specialization index, which shows the growing role of intermediate inputs for exports (which they call VS1) and the growing importance of one country as a supplier of intermediate inputs that are then exported by a second country (VS2). It is interesting to note that Canada is often an outlier in these measures, first as one of the few countries that did not see a growing share of trade to GDP over the period 1995 to 2005 as well as falling measures of vertical specialization. These findings are likely due to the rapid rise of the Canadian dollar over this period, which discouraged manufacturing exports as well as the growing importance of resources which have fewer intermediate inputs that can be imported. Other resource producers, such as Australia and Norway, saw similar trends.

The authors are also able to show a regional dimension to GVCs with particular countries serving as a GVC hub in their region, such as Germany in Europe, the U.S. in North America and Japan and China in Asia.

The rise of China may be the most significant economic event of the current generation, and one that it is intimately linked to the rise of GVCs. It is not clear to what extent China's rise was aided by the rise of global value chains, or vice-versa. But, there is no doubt that China plays a hugely important role in global value chains, especially those in Asia. China, as a huge and low-wage country, also epitomizes many of the fears in advanced countries related to the offshoring and outsourcing of activities. Alyson C. Ma and Ari Van Assche in their chapter "China's Role in Global Production Networks" explore in great detail how China is linked into Asian and global production networks[15], the role of China's export processing zones and of foreign invested enterprises. The authors are able to make a number of broad and important observations about China's role in production networks. Firstly they cast some doubt on the extent and the speed to which China is moving into increasingly technologically-sophisticated exports. They reach this conclusion based on the high degree to which processing exports account for China's highest technology exports. Processing exports, having little domestic content and largely produced by foreign invested firms, suggests that China simply hosts these activities and provides a labour-intensive, likely assembly role, with minimal links to the broader economy. There is also little evidence that this has been changing over time. The story is reversed for all other technology categories, however, with processing zones playing an ever smaller role, and both domestic content as well as the involvement of domestic firms increasingly rapidly.

Ma and Van Assche additionally point to the important role that geography plays in China's participation in global production networks. For Asian countries, China can be seen as a low-cost location from which to serve global markets. Inputs are sourced from across the region, assembly or other mostly labour-intensive activities done in China, and then exported globally -back to Asian markets, but importantly to the West as well. Essentially, for Asian countries, China serves as a low-cost export platform to the world. For Western countries, however, China appears to play a more limited role. A much lower share of imports are sourced from Western countries and the markets served are mostly Asian rather than global.

The final paper in this section "Global Value Chains in Canada" by David Boileau and Aaron Sydor relies largely on a new dataset coming from the recently completed Survey of Innovation and Business Strategies (SIBS). One component of that survey collects new data on the involvement of Canadian companies in global value chains as well as offshoring and outsourcing. Many of the results are, additionally, comparable to the survey conducted within the European Union which allows important comparisons between the two sources. Boileau and Sydor find that Canadian companies are indeed actively involved in global value chains and on a similar level to most EU countries, although far bellow the most engaged countries, most notably the UK and Ireland. An additional important finding is that although the rate of offshoring and outsourcing are fairly small, they are roughly evenly matched by the rate of inshoring. Thus, and as the theory would predict, offshoring and outsourcing are not one-way exoduses from Canada, and advanced countries more generally, but rather circular movements that also involve the inflow of activities to Canada. In the view of the authors, this changes the discussion

[15] A distinction being made between global production networks which are limited to merchandise trade and global value chains which includes services.

from one of how to deal with, if not prevent, offshoring and outsourcing, to one of how to make Canada an attractive location for high-valued activities and thus ensuring that the activities moving into Canada contribute to maintaining and improving the standards of living of Canadians. Some encouraging evidence is presented that Canada may be an attractive location for a number of high-valued activities. Research and development (R&D) activities are examined in some detail and shows that Canada appears to have a comparative advantage in performing R&D, a finding that is somewhat surprising considering Canada's relatively low R&D performance.

In terms of the drivers of offshoring and outsourcing, Boileau and Sydor report that push factors (those that drive activity out of Canada) are not particularly important, rather it is the pull factors of quickly growing markets and the opportunity to lower costs that are exerting a pull on some activities. As for barriers to offshoring and outsourcing, a number are identified that can be influenced by policy. Tariffs, for example, are identified by manufacturers as an important barrier which supports the need for continued tariff reductions. A number of the leading barriers though, deal with identifying potential suppliers, dealing with cultural and legal barriers and other factors that are expected when dealing with unfamiliar countries. These are areas where trade promotion programs, such as the Trade Commissioner Service (TCS) in Canada can play a role. Interestingly these factors of unfamiliarity show up as being more important for offshoring and outsourcing than they do for exporting for which export promotion programs were originally designed.

High Valued Activities

Most discussions of global value chains eventually lead to discussions about how to "move up the value chain". The preceding discussion of the theory underpinning GVCs made clear that activities will locate and grow in those locations that have a comparative advantage in those activities. That section also suggested that when trade is at a more granular level, small policy differences may also be more important. Thus it becomes increasingly important to understand what drives the location decision of the high-valued activities that are critical to maintaining and improving standards of living.

Research and development (R&D) is often viewed as among the most attractive and sought-after 'high valued' activities. Not only do R&D activities employ some of the most knowledge-intensive workers in an economy and provide high-paying jobs, R&D is also seen as having strong agglomeration economies (thus once you get some others might follow and it is more difficult to displace) as well as having significant spillovers (that is benefits beyond those that can be captured by the company performing the R&D). It is thus with great concern that policymakers in rich countries such as Canada see their share of global R&D falling and are concerned about their country's attractiveness as a location for performing this increasingly internationally footloose and highly desirable activity. But in "The Internationalization of R&D" Bronwyn Hall points out that it is actually rare that R&D activities are moved as there are large fixed costs in doing so and as already pointed out there are strong forces of agglomeration in R&D. Rather, for R&D activities, new facilities generally add to the R&D capacity rather than supplanting existing capacity. The statistics support this view - Canada along with most advanced countries are seeing their share of global R&D fall simply due to a growing share of R&D being performed in fast growing emerging economies. She does note, however, that in Canada a relatively high share of R&D is funded externally and the growth in that segment has been particularly slow since 2000. Although it is not clear what has been the cause of this stagnation, Hall finds it unlikely that there was a sufficiently important policy change over that period that

could account for the difference. A more likely explanation may be that, like much else, it has been a result of the rise of the Canadian dollar which has made Canada a relatively more expensive location in which to perform many activities, including R&D.

Headquarters (HQ) may also be viewed as a high-valued activity. There are the "headquarter activities" themselves - the services that the HQ provides to other parts of the organization, such as human resources, legal or accounting services, most of which tend to be high-knowledge well-paying jobs. Like R&D, HQs produce what may also be thought of as spillovers to the host jurisdiction by demanding legal, consulting and financial services. It is unlikely, for example, that a country could operate a thriving stock market without the presence of a sufficient number of large corporate headquarters. As Markusen (2005) notes, the loss of domestic service jobs associated with corporate head offices are among the biggest concerns in the trade policy area. Headquarters are different in at least one important respect, however, in that they make decisions that impact on the rest of the organization such as what type of activities are located where. To the extent that there may be links between the HQ and certain activities or a bias in the location decision, it may be extremely important where headquarters locate.

Michael Bloom and Michael Grant in their chapter "Valuing Headquarters (HQs): Analysis of the Role, Value and Benefit of HQs in Global Value Chains" looks at Canada's attractiveness as a location for corporate headquarters managing a global value chain. After increasing for a number of years, and importantly through many of the years where Canadians were concerned about the "hollowing out" of corporate headquarters following some high-profile mergers and acquisitions, the number of headquarters in Canada and number of headquarter employees peaked in 2005 but has declined since. Probably more important than this recent decline in numbers, Bloom and Grant also note that relative to other countries, Canadian companies tend to be rather small and less global. Looking at the Fortune Global 500, for example, they note that while Canada has a number of companies that is roughly proportionate to Canada's share of Global GDP, when measured by size (assets) and whether the company is considered a global leader, Canada ranks less well. Thus it appears that there is some evidence that Canada produces global companies, but there may be reason to believe that they are not growing to the global scale seen in many comparator countries.

Although it may appear that headquarters are not very footloose, many of the biggest companies have their headquarters at or close to where they were founded, headquarter functions can actually be reasonably mobile. High profile moves such as the recent move of Boeing's headquarter from Washington State to Chicago are indeed a rarity. But, the opening of regional or function headquarters, the consolidation of an HQ post merger or acquisition and changing the roles, responsibilities and mandates of different parts of the organization can indeed be quite common. It is for this reason that Bloom and Grant also examine the factors that make a location attractive for an HQ. They find that the general business environment and economic growth are the most important factors. Additionally, HQs often locate in urban centers, attracted by good transportation systems (both urban transit as well as national and international), access to skilled labour, and cultural and other amenities that are attractive to knowledge workers. The strength of the IP system was also noted as an important factor.

A Policy Perspective

As our understanding and measurement of GVCs improves, it will become increasingly important to deepen our understanding of the impact that the rise of GVCs

has for policy. To date, little work has been done on this issue. Baldwin notes, for example that identifying winners and losers in a GVC context is increasingly difficult. It is no longer the case that competition from international trade is limited to labour-intensive sectors while higher-skilled positions and services go largely unaffected. Within a global value chain context the nature of the task itself determines its ability to be offshored. Blinder (2009), for example, estimates that based on the nature of the tasks performed that nearly one-third of U.S. jobs are potentially offshorable.[16] As it becomes more difficult to identify which positions could be offshored, labour markets need not only focus on developing knowledge and skills but also a flexibility to adapt to a rapidly changing global environment. Furthermore, there will be political economy implications due to the increased difficulty for the winners from globalization to compensate the losers which may erode support for trade even if the gains remain positive or may have increased as argued by Globerman. Probably the most significant policy implication stemming from the rise of GVCs and identified by numerous authors, including both Globerman and Baldwin in this volume, is that comparative advantage will be determined at a much more granular level and that small policy differences may be becoming increasingly important.

For Canada, there are few studies that examine the potential policy implications of global value chains. Trefler (2006, 2009), for example, identifies few new policy issues but rather focuses on policy actions that would likely be considered as good ideas in any event, the rise of GVCs simply adds greater incentive to do them. These include, investing in education, opening markets, and removing distortions the reduce investments in productivity-enhancing machinery and equipment. The new policies identified by Trefler are largely limited to increased flexibility, for example the need for retraining for displaced workers or increasing the portability of pensions. He also discusses the need to protect intellectual property (IP) as well as enforcing health and safety standards. Dymond and Hart (2008) hypothesize about the potential impacts of GVCs for Canadian trade policy. They identify a number of areas where the rise of GVCs could have significant impacts on international trade, for example making rules of origin more important as inputs are increasingly sourced globally and on trade disputes as the country of export may play a relatively minor role in producing the good in question. They also identify global value chains as largely being regional value chains and thus put a great deal of focus on ensuring that trade between Canada and the U.S. operates efficiently in order to enhance the competitiveness of both countries internationally.

The theoretical basis for GVCs covered in the first section of this volume found that comparative advantage still applies, but is now more dynamic and applied at a finer level of detail. As a result, small policy differences may now be becoming more important. If that is the case, corporate taxes may be one area where the rise of GVCs could have an impact on policymaking. The "conventional wisdom" would likely be that higher tax rates that are not offset by (direct or indirect) productivity – enhancing public services make a location less attractive to investors, all other things constant. Bev Dahlby in his chapter "Global Value Chains, Foreign Direct Investment, and Taxation" finds that this "conventional wisdom" may not be a straightforward as one might expect. Making a link between trade theory and public finance he incorporates corporate taxes into a modified Grossman and Rossi-Hansberg (2008) trade in tasks model. The model shows that changes to home country tax rates can influence a firms decision to offshore vs. outsource (that is the decision to perform an activity abroad inside the firm and involve foreign direct investments vs outside the firm) and that the impact of a tax change in one country

[16] Of course that does not mean that they will necessarily be offshored.

must be taken in the context of the tax rates of all of the countries in which the firm performs activities. This complex relationship between corporate income taxes and the location of productive activities by firms is supported by his revue of the literature. Dahlby notes that the empirical literature has largely failed to produce a strong link between corporate taxes rates and FDI. There is some evidence, albeit limited, that FDI has become more sensitive to difference in corporate taxes rates in recent years, which would be consistent with the rise of GVCs.

During the global financial crisis, international trade fell to a much greater extent than did global GDP and by much more than most forecasters had expected. A number of reasons have been proposed for this overreaction of trade such as the double counting that occurs in trade due to GVC production, and the greater impact of the crisis on goods consumption relative to services. But an additional factor noted by some was the collapse in trade financing.[17] Apart from its impact during the crisis, trade finance may be impacted by the rise of global value chains more generally. It is in this context that Jean-François Lamoureaux and Todd Evans explore the potential impact of the rise of global value chains for trade finance in their chapter "Supply Chain Finance: A New Means to Support the Competitiveness and Resilience of Global Value Chains". They propose that under GVCs the need for export financing changes. It is no longer simply the exporter's competitiveness that matters, but also the competitiveness of all of the members of that exporter's supply chain. They additionally argue that Canada has few supply chain leaders – that is the very large companies that are often at the heard of GVCs and which may offer some of the supply chain financing options to their suppliers. Rather, most Canadian companies are lower tier suppliers in supply chains led by foreign companies resulting in limited supply chain financing options in Canada. This may put Canadian firms at a disadvantage relative to suppliers from other countries.

Just as export financing may be impacted by the rise of GVCs, so too may traditional logistics. As more intermediate inputs are moved and at potentially greater distances the efficiency of a country's logistics system can have a greater impact. In "Logistics and the Competitiveness of Canadian Supply Chains" Jacques Roy compares the efficiency of Canada's logistics system to that of other countries and finds that Canada's comes up short, ranking 14th overall. Well behind first ranking Germany. Roy attributes that poor ranking to a combination of government policies such as towards infrastructure, customs and differences in regulations between provinces as well as to a failure on the part of business located in Canada to adopt industry best practices and slow or lower rates of adoption of new technologies. Improving Canada's logistics system could contribute to making Canada a more attractive location internationally for those activities that make intensive use of logistics systems as well as improving the competitiveness of Canadian-based companies more generally.

International Experiences

The final section of the volume takes some tentative steps towards exploring how other countries have adjusted to the rise of global value chains with a view to drawing potential lessons for Canada.

Germany is of particular interest for those studying global value chains within manufacturing. Germany was, until recently, the world's largest merchandise exporter and is often view with envy by policy makers in advanced countries due to its success in

[17] See for example Mora and Powers (2009) and Cheung and Guichard (2009).

exporting relatively high-valued manufacturing products and its performance in fast-growing emerging economies. In a GVC context, Germany is situated in relative close proximity to low-wage offshoring destinations of Eastern Europe, both inside and outside of the EU as well as Russia, with abundant options for outsourcing and offshoring activities, but has maintained a vibrant manufacturing sector despite its relatively high wages.

In "The Role of Global Value Chains for German Manufacturing" Olivier Godart and Holger Görg develop a number of measures of global value chains to assess the extent to which German manufacturers are engaged in GVCs. The authors point out that despite the apparent opportunities for offshoring or outsourcing to near by low-wage countries, German manufacturing largely offshores or outsources to other high-wage countries within the EU, much as the U.S. is found to be the most important offshoring destination for Canada. Although the authors also note that growth for Eastern European countries is especially rapid. Even so, these countries are seen by German firms as part of a global offshoring and outsourcing strategy that includes low-wage countries globally and China in particular.

In addition to analyzing the extent and type of offshoring and outsourcing by German firms, Godart and Görg also look at the impact on German employment and wages. They find that the direct impact of offshoring by German manufacturers, including to low-wage countries in Eastern Europe or further abroad, has had an economically small negative impact on employment and on the wages of those engaged in the activities being offshored or outsourced. However, they also find a strong positive effect on the competitiveness of German manufacturing through improved labour productivity as well as a net positive impact on skill levels in Germany. This supports both the predictions of the economic theory as well as the evidence presented by Boileau and Sydor which emphasize the circular flow of activities for Canada. In both the German and Canadian cases, the offshoring or outsourcing of some activities to low-wage locations allows for increased competitiveness of domestic firms which translates into increased competitiveness, skills upgrading and the expansion of higher wage jobs.

Like Germany, the Nordic countries (Denmark, Finland, Norway and Sweden) also stand out as potential positive case studies for Canada when engaging in global value chains. The Nordic countries are situated on the periphery of and linked to a much larger economic bloc, they have strong public sectors with relatively even distribution of incomes, and they are seen as internationally competitive with high rates of innovation. Not only has growth in the Nordic countries often exceeded that of much of the rest of Europe but also stands in stark contrast to the recent performance of the countries on Europe's southern periphery. It is in this context that Jyrki Ali-Yrkkö, Petri Rouvinen and Pekka Ylä-Anttila in their chapter "The Nordic Model and the Challenge from Global Value Chains" examine the characteristics of the Nordic economic model in an era of global value chains.

Although the authors identify the Nordic economic model as having some weaknesses, such as an apparent lack of an entrepreneurial culture, overall the system is viewed by the authors as coping well with the rise of GVCs. Specifically the authors identify the importance of being open to international trade and investment combined with a focus on investing in education and on innovation as sources of advantage that continue to serve these countries well in a GVC framework. As with Canada and Germany, the authors find modest levels of offshoring and outsourcing and observe that the domestic economy has shifted to higher value-added activities as a result, with a likely net positive economic gain.

While it is always difficult to draw lessons from one country and apply it to another, this is particularly difficult in the case of lessons from the Nordics for Canada. Although indirect labour costs to business are high in the Nordic countries, wage growth is kept in check and competitiveness maintained through a social contract that has evolved and developed over many years. Similarly, corporate champions play an important role in the Nordic model. It is difficult to see how this can be translated to the Canadian case, or even if this is desirable and something that will continue to serve the Nordic countries as GVCs strengthen. Furthermore, while the statistics indicate a relatively high level of participation in GVCs through offshoring and outsourcing, it also seems likely that language serves, to some degree, as a source of insulation from these forces. It is after all likely much more difficult to find fluent speakers of Finish or Swedish in developing countries than it is for English, limiting some of the services that can be effectively offshored.

Further comparisons of different country's experiences with GVCs, offshoring and outsourcing seem an area where much more research should be undertaken. As better measures of GVCs are developed and special surveys of offshoring and outsourcing are conducted for additional countries, the scope for more detailed comparisons are increasing.

Concluding Thoughts

The studies in this volume represent an effort to better understand how global value chains function, what is driving their development and the potential implications for policymakers. To the extent that GVCs involve both the theory of international trade as well as that of FDI, it is hoped that this work will spur greater refinement of those linkages. It is somewhat surprising that more work has not been done on the drivers of global value chains. Difficulties related to measurement pose an important challenge for researchers, but this seems to be where some of the biggest advances are being made. All of the evidence seems to suggest that GVCs will not entail a transformative revolution in our understanding of trade or investment theory and there does not appear to be any fewer gains from trade – on the contrary, even greater gains seem possible. Rather, the biggest impact from the rise of GVCs may be that trade and competition is occurring on a much more granular level. Small policy differences may have a greater impact for outcomes – wages, jobs, and productivity improvements. Understanding what policy differences matter most for attracting and retaining the high-valued and innovative activities will contribute to improved standards of living.

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Global Value Chains: Economic And Policy Issues

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1. Introduction

"Companies no longer compete – Value Chains Compete" (Murphy, 2007, p.11)

In the past few years, a fairly substantial literature has emerged addressing the phenomenon of global value chains (GVCs). While one can find various definitions of GVCs, the simple concept proposed by Lunati (2007) seems to capture the spirit of most definitions. Namely, GVCs are international supply chains characterized by fragmentation of production activities across sites and borders. In effect, the whole process of production, from acquiring raw materials to producing and delivering a finished product, has increasingly been "sliced", so that each activity that adds value to the production process can be carried out wherever the necessary skills and materials are available at competitive cost (OECD, 2007; Feenstra, 1998). A related explanation of the GVC phenomenon is provided by Borga and Zeile (2004) who characterize the GVC phenomenon as the increasing divisibility of production activities. That is, production activities can be increasingly divided into different stages that can be performed in different locations.

The GVC phenomenon has, in turn, been linked to the concept of international outsourcing ("offshore outsourcing"), although they are conceptually distinct. In the vertically integrated firm, the production process is divided into separate stages with different units of the firm specializing in particular stages of production. The two phenomena are linked, since there is a perception that value chain activities that are sited overseas are increasingly being carried out by independently owned companies, rather than by affiliates linked by ownership to the companies doing the contracting-out.[1] Coombs, *et. al.* (2003), among others, argue that products are nowadays provided to the market through iterative sequences and complex interactions among a variety of agents. The modern corporate model involves firms focusing on "core competencies" with greater specialization combined with strategic sourcing and partnering.

The claim that global value chain activities are increasingly being carried out by independently owned firms rather than by overseas' affiliates of the outsourcing

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[1] Antras (2005) links the GVC and off-shoring phenomena as related strategic decisions in noting that in developing their global sourcing strategies, firms not only decide where to locate the different stages of the value chain, but also the extent of control they want to exert over those processes.

(multinational) firm distinguishes offshore outsourcing from either simply "off-shoring" or "outsourcing". Hence, the modern corporate model is increasingly viewed as being "networked-based" with growing international specialization and focus on "core competencies" combined with strategic sourcing and partnering involving independently owned companies (Cusmano, Mancasi and Morrison, 2008; Manning, Massini and Lewin, 2008).

Neither the international specialization of specific value chain activities, nor offshore outsourcing, are new developments, although the speed and scale of offshore outsourcing activities are suggested to be increasing (OECD, 2007).[2] With respect to the geographical relocation of value chain activities, what is argued to be different about recent experience is that international trade is becoming increasingly concentrated in intermediate inputs rather than finished products (Antras, 2005; Krywulak and Kukushkin, 2009). Furthermore, while first identified for manufactured products, the phenomenon of greater value chain specialization and trade in intermediate inputs is also noted to be occurring increasingly in services, along with offshore outsourcing of services (Markusen and Strand, 2006).

There is also a view that *every* stage of an organization's value chain is increasingly capable of being relocated anywhere in the world based on where it can be performed most efficiently. The relocation of research and development (R&D), product design and other innovation-related activities has been particularly noted in the recent literature.[3] With modern communications and efficient transportation networks, the various stages can be linked to each other in a relatively smooth manner spanning increasingly greater physical distances (Sydor, 2007). The rise of China as a major site for outsourced manufacturing value-added activities and of India as a site for outsourced service-related activities have been intensively discussed in this regard (Trefler, 2005).

1.1 Focus of Report and Research Issues Addressed

The broad purpose of this paper is to synthesize and critically evaluate the literature concerned with both GVCs and offshore outsourcing and the factors contributing to the growth of these phenomena. A particular goal is to assess whether the phenomena are capable of being understood by existing theories of international production. If not, what is incompletely or unsatisfactorily explained by existing theories of international production? A related goal is to identify and evaluate whether conclusions regarding the economic gains from international production and trade, including trade among affiliates of multinational companies (MNCs), need to be modified or reversed when applied to trade in intermediate inputs accomplished through offshore outsourcing. The "conventional" view amongst most economists and international business scholars is that increased specialization of production across countries leads to higher real income levels for those countries participating in global economic integration. Is this view still appropriate?

This conventional view has been subjected to questioning in recent years. In assessing whether the conventional wisdom regarding the economic benefits of international

[2] Indeed, Mankiw and Swagel (2006, p.10) assert with respect to imports related to GVCs and offshore outsourcing: "Whether things of value, whether imports from abroad, come over the Internet or come on ships, the basic economic forces are the same."

[3] See, for example, Lewin, Massini and Peeters (2009), Manning, Massinii and Lewin (2008), Asakawa and Som (2008), Sydor (2007) and Ojah and Monplaisir (2003).

specialization of production still seems appropriate in light of the GVC phenomenon, the paper will consider whether the "drivers" of GVCs and offshore outsourcing are fundamentally different from the traditional determinants of international production and trade patterns. As a related issue, the report will identify and evaluate recent policy recommendations that have been made to enhance the "home country" economic benefits of GVCs and offshore outsourcing. In particular, we will consider whether recent recommendations differ substantively from those made in the past with respect to increasing the net economic benefits of international trade and foreign direct investment (FDI).

1.2 Outline of Report

The paper proceeds as follows. Section 2 contains a relatively condensed statistical overview of recent changes in international trade involving intermediate inputs, including service inputs, as well as offshore outsourcing. The focus of this section is both on the absolute growth of these activities, as well as growth relative to global international trade flows. Among other things, attention will be paid to whether and to what extent activities traditionally carried out at corporate headquarters, particularly research and development, are being partly or wholly relocated geographically, as well as the extent to which the international relocation is accompanied by outsourcing.[4] Section 2 will also address whether and how recent Canadian experience with trade in intermediate inputs and offshore outsourcing differs from that of other OECD countries.

Section 3 presents an overview of conventional theories of international production, particularly the determinants of the international specialization of production encompassing the allocation of value chain activities across firms, i.e. make-or-buy decisions. Section 4 provides an evaluation of whether and how conventional theories of international production need to modified or extended in order to explain in a satisfactory manner the phenomena of increased trade in intermediate inputs (including services) and offshore outsourcing. This evaluation includes a consideration of whether new drivers of international trade and outsourcing have emerged in recent years. Relevant theoretical contributions to the literature on international production will be reviewed, as well as empirical studies identifying the main determinants of international production specialization and trade. Recent theoretical and empirical studies of offshore outsourcing will also be reviewed and assessed.

Section 5 will identify and assess policy recommendations that have been made to enhance the home country economic benefits derived from the GVC and offshore outsourcing phenomena. Section 6 provides a brief summary and conclusions.

2. The Growth of GVCs and Offshore Outsourcing

There is no consistent time series evidence on the extent to which trade in intermediate inputs has changed over time. Nor is there consistent evidence on the magnitude of offshore outsourcing activities over time. Furthermore, the evidence that is available is largely based on surveys that are specific to particular time periods and/or locations.

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[4] As Markusen (2005) notes, the loss of domestic service jobs associated with corporate head offices are among the biggest concerns in the trade policy area, so a particular focus on vertical specialization and offshore outsourcing of traditional headquarters' services seems appropriate.

2.1 Imports of Intermediate Inputs

The available information, albeit fragmented, is consistent in documenting the growth of imported intermediate inputs in total domestic production. One frequently cited source is Feenstra and Hanson (1997) who report that imported inputs increased from 5.7% of total U.S. intermediate goods purchases in 1972 to 8.6% in 1979 and to 13.9% in 1990.

Table 1 reports similar data for all manufacturing industries for comparable years for the United States, Canada, Japan and the United Kingdom. Specifically, it reports the share of imported to total intermediate inputs for each country in each sample year (Feenstra, 1998). For the two large economies (U.S. and Japan), the share of imported inputs in total inputs is smaller than for the two smaller economies (Canada and the U.K.). This might be expected to the extent that smaller economies will be driven to specialize in a narrower range of products than larger economies in order to realize attainable product-level economies of scale.

Table 1: Share of Imported to Total Intermediate Inputs

(All Manufacturing Industries – percent)

Country	1974	1984	1993
Canada	15.9	14.4	20.2
Japan	8.2	7.3	4.1
U.K.	13.4	19.0	21.6
U.S.	4.1	6.2	8.2

Source: Feenstra (1998)

Table 2 reports shares of imported total intermediate inputs for specific manufacturing industries for 1974, 1984 and 1993. What is interesting to note here is that the growing importance of imported intermediate inputs as a share of total intermediate inputs varies across manufacturing industries. For example, growth is more marked in the case of transportation equipment than it is in the case of chemicals and allied products. While no explanations are offered for the observed differences across industries, it is not surprising to find that GVCs seem most developed in the transportation equipment industry given the high degree of intra-industry trade within the motor vehicle and parts industries.

Table 2: Share of Imported to Total Intermediate Inputs

Various Industries (Percent)

Chemicals	**1974**	**1984**	**1993**
Canada	9.0	8.8	15.1
Japan	5.2	4.8	2.6
U.K.	13.1	20.6	22.5
U.S.	3.0	4.5	6.3
Industrial Machinery			
Canada	17.7	21.9	26.6
Japan	2.1	1.9	1.8
U.K.	16.1	24.9	31.3
U.S.	4.1	7.2	11.0
Electrical Equipment			
Canada	13.2	17.1	30.9
Japan	3.1	3.4	2.9
U.K.	14.9	23.6	34.6
U.S.	4.5	6.7	11.6
Transportation Equipment			
Canada	29.1	37.0	49.7
Japan	1.8	2.4	2.8
U.K.	14.3	25.0	32.2
U.S.	6.4	10.7	15.7

Source: Feenstra (1998)

In a more recent contribution, Feenstra and Jensen (2009) discuss measurement and technical problems with previous estimates of materials offshoring, i.e., imported intermediate inputs. In particular, previous studies make the assumption that an industry's imports of each input, relative to total demand for that input is identical to economy-wide imports relative to total demand for that input. To address the potential shortcoming arising from this assumption, Feenstra and Jensen link production and import data to construct firm-level input-output tables and then aggregate these data to the industry level in order to derive imported input intensities by industry for the United States. They compare estimates using the original Feenstra-Hanson calculations to their revised calculations for selected years from 1980-2006. In fact, for most manufacturing industries, the results are similar regardless of how materials offshoring is measured. Across their sample of manufacturing industries, imported intermediate inputs as a share of total intermediate inputs increased by a factor of 200 percent to 300 percent when comparing 1980 to 2006.

Trefler (2005) provides an estimate of offshoring of services for the Canadian economy overall. He uses balance of payments data for services trade for 2004 and focuses on "computer and information services" and "other business services" as being most likely to include services such as those provided by white collar workers in India to customers in Canada. These two categories together account for $20.4 billion in exports and $18.1 billion in imports. Trefler then compares these amounts to Canada's trade in goods. The latter dwarf the former. For example, Canada's 2004 goods exports were $430 billion compared to the approximately $20 billion in exports for the two service categories; however, he argues that a more meaningful comparison would be to the portion of goods' exports that represents value added created in Canada. In this case, the relevant goods export measure equals $143 billion. Trefler's interpretation is that Canada's trade in white collar-type services is small but not inconsequential.[5]

A number of other studies also report evidence identifying the increased trade in intermediate inputs. For example, estimates by Campa and Goldberg (1997) based on input-output tables show large increases over the period 1974-1995 in the share of imported intermediate inputs in manufacturing industry output for the U.S., Canada and the U.K. In contrast, the share for Japan was found to decrease. Hummels, Ishii and Yi (2001) estimate shares of imported intermediate inputs embodied in a country's exports. Their calculations from input-output tables reveal that vertical trade as a share of total exports increased for most of the major OECD countries between 1970 and 1990 by up to 25 percent to 33 percent.

Finally, the Conference Board of Canada (2008) divides North American goods trade into three stages- primary, partly finished inputs and finished goods- in terms of where they enter into other regions' supply chains. It finds that the share of trade in inputs increased dramatically over the 1990s but fell over the period 2000-2003. It then increased to finish slightly higher (at around 30%) in 2006 compared to its value in 2003. The Conference Board concludes that the integration of goods production in North America basically stalled in the post-2000 period; however, it also concludes that Canada has become more integrated, especially in recent years, into the supply chains of other regions of the world, albeit starting from a low base. In particular, Canadian firms are rapidly integrating Asian inputs into their production networks; however, they are not tapping into Asian supply chains as suppliers. Hence, the overall amounts of integrated trade for Canada outside of North America remain modest.

In short, the available evidence (summarized in Figure 1) suggests that developed countries, including Canada but possibly excluding Japan, are using intermediate inputs more intensively in domestic production; however, this should not be seen as direct evidence of increased international vertical specialization of production, nor of increased offshore outsourcing. Specifically, it is not direct evidence of increased specialization of production along the value chain, since imported inputs might simply be displacing domestically produced inputs within the same value chain activities.[6] It is not direct evidence of increased offshore outsourcing, since the estimates discussed above do not distinguish "arms-length" imports from intra-firm imports. Finally, from a Canadian perspective, it is worthy of notice that the integration of North American production in

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[5] Additional data on outsourcing by Canadian firms is provided in Goldfarb (2004).

[6] In this regard, however, Borga and Zeile (2004) provide evidence that intra-firm trade in intermediate inputs is particularly marked in industries characterized by divisibility of the production process. This suggests that the U.S. MNCs involved in their sample are increasingly engaged in vertical specialization.

terms of bilateral trade in intermediate inputs seems to have slowed in the post-2000 period compared to the 1990s, while integration with fast-growing Asian economies seems primarily to involve Canada imported inputs from China while selling raw materials to China.

Figure 1. Summary of Empirical Evidence on GVCs

Author(s)	Region	Time Period	Conclusions
Feenstra & Hanson (1997)	U.S.	1972, 1979, 1990	Imported inputs as a share of intermediate goods imports more than doubles
Campa and Goldberg (1997)	U.S., Japan, Canada, U.K.	1974-1995	Increase in imported inputs as a share of mfg. output for Canada, U.S. & U.K.
Feenstra (1998)	U.S., Japan, Canada, U.K.	1974, 1984, 1993	Importance of GVCs varies across countries and industries. Canada is more integrated compared to others
Hummels, Ishii & Yi (2001)	Major OECD countries	1970-1990	Imported inputs as a share of total exports increased by about 30% for most countries
Conference Board (2008)	North America	1990-2006	North American GVCs expanded in 1990s and then expansion stalled
Feenstra & Jensen (2009)	U.S.	1980-2006 various years	Imported intermediate inputs as a share of total inputs more than doubled

2.2 Relocation of R&D Activities

There is a limited amount of evidence available on the relocation of R&D activities, and most of it is fragmentary based upon surveys carried out at specific points in time. Cantwell (1995) shows that in the 1930s, the largest European and U.S. firms carried out only about 7 percent of their total R&D at locations abroad; however, this figure has steadily risen since the 1960s. Kuemmerle (1999) shows that in 1965 the 32 MNCs studied in his paper carried out 6.2% of their R&D efforts outside the home country boundaries, whereas in 1995, the corresponding figure was 25.8 percent. Asakawa and Som (2008) discuss the growing number of Western and Japanese firms that have been launching R&D operations in China and India. Other surveys provide essentially similar information.

In a recent survey overview, Huggins, Deminbag and Iankova (2007) discuss how R&D strategies and international location decisions have changed substantially in the direction of greater decentralization and cross-border knowledge interdependence. The extent of this process is evidenced by MNEs across all industry sectors allocating an increasing proportion of their R&D abroad. The authors claim that of those products that move in international commerce, R&D-intensive goods are the fastest growing segment.

The authors draw on a database of all announced and realized R&D investment projects undertaken by MNEs between 2002 and 2005. They found that in both Europe and, especially in North America, there was a substantial increase in R&D undertaken outside the home country relative to home country R&D as carried out by MNCs. In general, FDI-related R&D has been centered in a number of key locations in India and China. The key sectors for R&D FDI by total investment are IT and software, semiconductors and pharmaceuticals.

Dunning and Lundon (2009) also highlight the increasing importance of external knowledge sourcing by noting that in 2003, the ratio of contract research to in-house R&D was 5.6% for all U.S. industries, whereas it was only 3.7% in 1993. It should be noted that contract research can include research undertaken by domestic firms, as well as foreign-based firms. Hence, it is possible that a substantial portion of the increase in contract research identified does not involve offshore outsourcing. Indeed, Dunning and Lundon summarize the results of several recent surveys indicating that the internationalization of innovative activities by multinational enterprises has lagged behind their internationalization of production activities.

Bardhan and Jaffee (2005) discuss some original evidence indicating that there has been a limited amount of offshore outsourcing of R&D to date. As well, offshore outsourcing has been focused on a specific type of R&D. Specifically, from a survey of approximately 50 California-based high-technology firms, they found that domestic outsourcing was the largest and most common form of outsourcing resorted to by reporting firms. Furthermore, outsourced R&D was primarily undertaken by the reporting firms' foreign affiliates. Interviews suggested that relatively routine development activity was subcontracted to arms-length parties, while more "sensitive R&D was carried out by the firm's foreign affiliates. A supporting observation is that reporting firms preferred to carry out "drastic" innovations embodying substantial improvements in existing products and processes within the firm, while R&D involving marginal improvements are candidates for outsourcing.

Additional evidence suggesting differences in the nature of the R&D being undertaken influence the likelihood of the R&D being outsourced is reported by Cohen, Di Minin, Motayama and Palmberg (2009). Specifically, they focus on the separation of "important" R&D from "routine" R&D in the wireless telecommunications and automobile industries and find that important R&D exhibits a strikingly strong "home bias." Their analysis is based upon a classification of patents into "essential" and "unessential" categories for the two industries. They define important and unimportant R&D based upon whether the R&D is associated with essential or inessential patents, and they then compare the location of the inventive teams behind essential and non-essential R&D. In spirit, this finding is similar to the one reported by Asakawa and Som (2008) who discuss the growing number of Western and Japanese firms that have been launching R&D operations in China and India. They note that firms tend to locate more technologically advanced R&D tasks in developed countries which are more likely to provide infrastructure necessary to conduct state-of-the-art research.

In summary, there is certainly evidence of R&D activities being relocated to foreign locations, although there is relatively little evidence on how much offshored R&D is being done by affiliates of the outsourcing firms versus being done by independently owned firms. The available evidence is fairly persuasive that outsourced R&D tends to be of a more routine and less important nature than the R&D performed in the home country.

As noted above, while the offshoring of R&D activities has been seen by some as a challenge to traditional models of international production, that contention will be

reviewed in more detail in a later section of this report. It is merely noted at this point that the distinction between routine and non-routine R&D, insofar as outsourcing activity is concerned is a potentially important one in assessing whether the growth of R&D outsourcing is a challenge to conventional theory regarding international production.

3. International Specialization of Production

In the international business literature, the so-called eclectic paradigm of international production is the underlying conceptual model explaining patterns of international specialization, as well as whether multinational firms exploit firm-specific advantages directly, by producing the input in question, or whether production is "contracted-out" to a third party (Dunning 1973, 1988 and 2001). Specifically, the eclectic paradigm addresses two broad issues related to patterns of international production: 1. where should any specific production activity be carried out? 2. which specific firm(s) should carry out the activity? The second point is related to the issue of whether multinational firms should "internalize" specific production activities or whether they should outsource the activities to independently owned firms.

These two broad issues are obviously directly relevant to the GVC and offshore outsourcing phenomena. The GVC phenomenon encompasses the issue of why increasingly narrowly defined value-chain activities (i.e. production of intermediate inputs) are being carried out in different international locations. The offshore outsourcing phenomenon is essentially concerned with the issue of why MNCs are increasingly choosing to contract-out specific value chain activities to independently owned firms located in foreign locations, rather than having those activities carried out by their own affiliates in the relevant foreign locations.

3.1 Location-Specific Advantages

The eclectic paradigm embodies the straightforward presumption that any value-chain activity should be located geographically where it is most efficiently carried-out. Locations have a variety of attributes that make them more or less efficient sites for specific value-chain activities. International competition will, in turn, ensure that firms indeed locate activities in those sites where they are most efficiently carried out.

Traditional international trade theory identifies potential determinants of the advantage that particular locations have with respect to specific production activities. Specifically, in traditional international trade models of the Heckscher-Ohlin (H-O) variety, a country (or region) will enjoy a location (or comparative) advantage in those activities that utilize intensively factors of production that are relatively abundant in the specific country (region), and are therefore relatively inexpensive compared to other countries (regions). The extension of the H-O model to the production of intermediate inputs would suggest straightforwardly that any intermediate input will be produced in locations enjoying a comparative advantage in the relevant production activity.

Indeed, several economists have asserted that the GVC phenomenon is completely consistent with the H-O model, where products are narrowly defined intermediate inputs rather than final goods. For example, Markusen and Venables (2007) posit that fragmentation of the production function allows a country to import just that part of a final good in which it does not enjoy a comparative advantage, instead of importing the whole good; however, no claim has been made that the GVC phenomenon is completely consistent with the H-O model. In this regard, Markusen (2005) highlights the fact that

there is no one "grand model" which includes all possible bases for international trade or for partial or complete international specialization of production.

Markusen distinguishes specifically between comparative advantage theories of trade and non-comparative advantage theories of trade. The former encompass Ricardian and H-O determinants of trade. Ricardian models emphasize differences in technologies as determining the volume and direction of international trade flows. H-O models, as noted above, emphasize differences in factor intensities across production activities, along with differences in technologies as determinants of location advantage. Non-comparative advantage (or industrial organization) theories of trade highlight scale economies, imperfect competition and product differentiation as motivators of international trade.

3.2 Imperfect Competition and Other Influences on Trade

The distinction between comparative advantage as the basis for international trade versus scale economies, imperfect competition and/or product differentiation as the basis for trade corresponds, in part, to the distinction in the international business literature between location-specific advantages and firm-specific advantages. The latter refer to resources (broadly defined to encompass brand-name products, proprietary knowledge and product designs, scale and scope economies and so forth) that enable a firm to out-compete other firms in any specific value-chain activity and, therefore, to carry-out that activity in its preferred location(s).

To the extent that firm-specific advantages are largely independent of location-specific advantages, the influence of comparative advantage on the geographic pattern of international production is potentially diminished, since the location of specific production activities need not be strictly dictated by considerations of economic efficiency. Put differently, if firms enjoy certain competitive advantages derived (directly or indirectly) from market power, they have some scope to "dissipate" those advantages by locating production activities according to criteria other than efficiency, e.g., a preference on the part of senior managers to live in a particular location that is not the most efficient location for the activity in question.

In fact, comparative advantage-based models of international trade recognize that "market imperfections" can contribute to patterns of international production departing from patterns strictly predicted by comparative advantage (Staiger, Deardorff and Stern, 1987; Bergstrand, 1985). In some cases, market imperfections are created by tariffs and other government-imposed trade distortions. In other cases, market imperfections reflect what were identified earlier as firm-specific advantages related to market power, the possession of exclusionary intellectual property rights and so forth. In short, even the staunchest advocates of comparative (location) advantage as the basis for determining international geographic patterns of production would not claim that comparative advantage offers a complete explanation of the location of most production activities. Nevertheless, it is still a legitimate question to ask if comparative advantage is an increasingly less robust determinant of international production patterns as production activities are more finely fragmented along the value chain. Empirical evidence on this question will be reviewed in a later section of this report.

3.3 Firm-Specific Advantages and Outsourcing

In the eclectic model, as noted above, a host of factors potentially underlie firm-specific advantages. Indeed, since foreign firms generally experience various disadvantages (or liabilities) associated with doing business in locations with formal and informal

institutions different from those of their home markets, they must possess compensating competitive advantages in order to overcome specific liabilities of foreignness (LOFs) from which they suffer. In the broad FDI literature, intangible assets in the form of proprietary technology, managerial know-how, goodwill associated with brand name products and so forth are the main sources of MNCs' firm-specific advantages. Furthermore, within the eclectic model, as well as within the broad transaction cost literature, MNCs will choose to internalize their firm specific advantages, i.e., carry out themselves the value chain activities that draw upon the relevant intangible assets, when the transaction costs associated with engaging independently owned firms to utilize those assets in one or more value chain activities are prohibitively high, such that it is more efficient to carry out the value chain activities within its own foreign-based affiliates.

The internalization of production and trade within the MNC is generally explained by the transaction cost model. While it is beyond the scope of this paper to discuss the elements of transaction cost economics in detail, the main point is that the costs associated with arranging, monitoring and modifying transactions may be substantially higher when those transactions are carried out with arms-length partners than when carried out within the firm. Attributes of the relevant transactions, as well as the competitiveness of the relevant markets, will condition transaction costs. Presumably, there are potential economies associated with using outside suppliers including possible economies of scale and scope enjoyed by those suppliers; however, for many transactions, those economies might be more than offset by the incremental costs of transacting with independently owned suppliers and distributors.

Transactions encompassing activities whose sought-after outcomes are difficult to codify in advance, as well as highly uncertain in terms of achievability are typically thought of as having relatively high transaction costs and, therefore, likely to be internalized within the MNC. A traditional illustration of this type of activity is R&D. Yet the import of recent discussions of the outsourcing phenomenon is that more and more activities that formerly were internalized within the MNC are being outsourced to independently owned firms located abroad. In this context, those discussions raise the issue of whether existing theories of outsourcing need to be revised, and/or whether the empirical importance of transaction cost determinants are decreasing over time and, if so, why.

The empirical literature documenting the importance of transaction costs as a determinant of "make-or-buy" decisions by MNCs is too extensive to be reviewed in this report. Suffice to say that, as in the case of H-O models of international trade, transaction cost models of outsourcing decisions are less than fully deterministic. That is, proxy measures of transaction costs do not, by themselves, fully explain outsourcing decisions; however, the relevant issue from the perspective of this report is whether the transaction cost model is significantly less predictive as a determinant of outsourcing decisions when the value chain activity involves the production of specialized intermediate inputs, particularly those that involve what are traditionally identified as "white-collar" workers. This issue will also be considered in a later section of this report.

3.4 Policy Issues

As noted above, international specialization of production is hardly a new phenomenon, and the empirical evidence documenting the economic benefits of international specialization of production accompanied by international trade is too voluminous and well known to review here. To the extent that the growth of GVCs raises any new issues, it is arguably because the more "finely grained" international specialization

of production does not give rise to the same efficiency gains as broader patterns of geographic production specialization accompanied by trade, e.g., trade in finished goods. Arguably, any evaluation of the GVC phenomenon should therefore consider whether and why the gains from the international specialization of production might depend upon the degree of specialization characterizing any value chain. In particular, if international production specialization results in the relocation of any specific value chain activity to a location enjoying a comparative advantage in that activity, a more fine-grained (or extra-marginal) international specialization of production should lead to even more of the same "good thing", i.e., increased efficiency and higher real incomes at the national level. Put differently, a policy issue raised is whether the gains from specialized production and international trade at the level of the home country should depend upon the extent to which specialization and trade increasingly encompasses intermediate inputs of all sorts as opposed to finished and semi-finished goods.

It was also noted above that MNCs have historically been instrumental in relocating production activities from home to host countries by undertaking FDI and coordinating international trade among their affiliates. While the evidence on the impacts of offshoring by MNCs is less voluminous than the available evidence on the gains from international trade, the basic conclusions are similar. Specifically, to the extent that the relocation of production activities within MNCs, accompanied by intra-firm trade, makes the process of international specialization of production more efficient, offshoring should contribute to higher real income levels for both host and home countries (Globerman, 1993). Furthermore, if outsourcing offshore production is more efficient for the MNC than carrying out offshore production in its own foreign affiliates, then offshore outsourcing should further improve the economic welfare of home countries. The policy question raised by expressions of concern about offshore outsourcing is, therefore, why should offshore outsourcing be economically disadvantageous for home countries when offshoring carried out within MNCs is economically advantageous?

In short, the policy issues surrounding GVCs and offshore outsourcing can seemingly be distilled into two relatively focused conceptual and, perhaps, empirical questions in the context of a fairly broad and consistent literature identifying net economic benefits to countries specializing in international production while trading with other countries, often using MNCs to carry out international trade: 1. why might be the net economic benefits from specialized international production diminish when specialization involves more narrowly defined value chain activities? 2. why might the net economic benefits of offshoring by MNCs diminish if overseas production is outsourced to independently owned companies rather than carried out by the MNC's foreign affiliates?

These policy issues will be addressed in a later section of the report. Before doing so, it is useful to assess whether traditional theories of international production and outsourcing are rendered less relevant with the emergence and growth of GVCs. Both theory and empirical evidence on this issue are presented in the next section of this report.

4. Criticisms of the Conventional Wisdom

In this section of the report, we identify and assess various recent criticisms that have been directed at traditional theories of international production and trade, as well as at offshore outsourcing, insofar as GVCs are concerned. We also review some recent empirical evidence bearing upon the practical relevance of those criticisms.

4.1 Theories of Trade as Applied to Intermediate Inputs

Claims have recently been made that traditional theories of international trade must be substantially modified when applied to trade in intermediate inputs as compared to trade in final goods and services. Perhaps the most explicit statement of the shortcomings of the concept of comparative advantage as applied to modern international trade has been proposed by Michael Porter.[7] Porter argues that traditional trade theory, based around the idea of comparative advantage, focuses on a country's factor endowments of land, labour and capital, but that is not what is driving current patterns of trade between nations. Specifically, Porter argues that the international mobility of financial capital renders domestic endowments of that specific input an irrelevant determinant of comparative advantage. He further argues that it is not so much the quantity of labour that affects a nation's "competitiveness" in a given economic activity, but rather it is the specialized nature and "quality" of labour that is important.

It is somewhat unclear whether Porter is suggesting that the quality of labour is a newly important factor of production or whether previous studies of international trade failed to acknowledge the existence of different qualities of labour. In fact, neither interpretation seems defensible. In particular, both conceptual and empirical studies of North-South trade and FDI flows highlight the importance of human capital abundance in the North as a major determinant of trade and FDI flows from North to South.

Other authors offer a more specific criticism of traditional comparative advantage-based models of international production in claiming that those models are not relevant to understanding the relocation of value chain activities, such as R&D. For example, Lewin, Massini and Peeters (2009, p.901) assert that: "The reasons underlying the decisions by firms to offshore value-adding innovative activities remain to be understood conceptually as well as empirically." Others have indirectly suggested that comparative advantage is an increasingly misguided theory of international production with the growth of vertical specialization, particularly with the separation of the R&D and product design stages of the value chain from the manufacturing stage. In particular, the offshoring of "high-end" business processes and other administrative and technical services to developing countries such as China and India is seen as challenging the relevance of comparative advantage-based models, since developed countries are presumed to enjoy a relative abundance of highly skilled scientists and engineers (Manning, Massini and Lewin, 2008).

On balance, it seems fair to conclude that most criticisms of the application of comparative advantage-based models to GVCs rest not on specific theoretical considerations but, rather, derive from the empirical observation that the international specialization of value chain activities increasingly involves R&D, product design and other white collar-intensive activities being relocated to countries that historically have experienced comparative disadvantages in those activities. One possibility that is consistent with traditional theory is that patterns of comparative advantage are changing with a shift in the global pool of scientists and engineers. In this regard, Manning, Massini and Lewin (2008) among others note that the number of U.S. and European scientific and engineering (S&E) graduates is stagnating, while the pool of S&E talent in emerging economies such as China and India is growing rapidly. Nevertheless, there are few experts who would argue that China and India are more human capital intensive in relative terms than the U.S. and Europe. Hence, the relocation of human capital intensive activities to

[7] Porter's arguments are discussed in Snowson and Stonehouse (2006).

emerging market economies seems, on the surface, to contradict the predictions of H-O type models.

In fact, Markusen (2005) provides an explanation of the offshoring of white collar services to developing countries such as China and India that is consistent with comparative advantage-based models of international production. Specifically, Markusen posits that while white collar workers in developing countries are relatively scarce in number compared to their counterparts in developed countries, the former are relatively cheap compared to the latter because the former have relatively low marginal productivities. The reason is that knowledge is a complementary input to skilled labour, and developing countries are relatively deficient in knowledge. It is therefore efficient to move some production to developing countries where that production utilizes relatively intensively the services of white collar workers who specialize in activities where knowledge is a relatively weak complement, e.g., call centers. On the other hand, production that utilizes relatively intensively the services of white collar workers with skills that are strong complements to knowledge will remain concentrated in developed countries.

Markusen's model, in effect, suggests that white collar activities across stages of any GVC should be differentiated by their knowledge-intensity. As specialization of production increases, degrees of knowledge intensity of specific value chain activities are increasingly relevant determinants of comparative advantage. In particular, one might well observe activities such as R&D and product design being offshored to countries such as China and India, but the offshored R&D and product design activities are likely to be significantly less knowledge-intensive than those whose production is concentrated in developed countries. In this context, the issue of whether or not recent trade in intermediate inputs simply requires finer classifications of comparative advantage in order to be consistent with H-O type models is an empirical one. In the next section, some available evidence on the issue is summarized and assessed.

4.1.1 Trading Tasks

Arguments have been made that while comparative advantage still generally determines the geographical pattern of trade in intermediate inputs, some important inferences drawn from H-O type models of trade in final goods are unreliable when those models are applied to the offshoring of intermediate inputs. In this regard, Grossman and Rossi-Hansberg (2006; 2008) discuss the offshoring phenomenon in terms of "trading tasks' whereby the production process is modeled as a continuum of discrete tasks. Within this framework, offshoring of specific tasks can lead to productivity improvements in the importing sector which, in turn, can lead to an expansion of output in that sector and an increase in wage rates for factor inputs in that sector. Furthermore, offshoring of specific tasks can occur even in sectors of the economy that enjoy a comparative advantage. Put differently, a country might be at a comparative disadvantage in one or more specific tasks, even if it enjoys a comparative advantage in the bulk of the tasks carried out in a particular industry. Offshoring the tasks for which other locations enjoy a comparative advantage could increase productivity in the tasks retained by the outsourcing firms.

Since specific tasks might be outsourced in virtually all sectors of an economy, Baldwin (2009) argues that a fundamental difference between the trading tasks models of trade and older models of trade is that, since offshoring can affect all sectors, it is unclear which groups in society will gain or lose from increased trade intensity. In particular, the relative productivity and wage effects of offshoring tasks are uncertain. More important,

perhaps, it is unclear whether any specific nation will gain or lose from increased trade. For example, to the extent that there are technology spillovers across countries associated with outsourcing tasks, domestic firms engaged in offshore outsourcing might collectively undermine the competitive advantages they enjoy in international markets as offshore rivals acquire capabilities similar to those of the domestic firms through international technology transfers. Increased competition from offshore firms might, in turn, adversely affect the terms-of-trade for a nation, as export prices decline owing to increased supply of the intermediate inputs or final products affected by the increased competition.

While modeling offshoring as trade in tasks rather than trade in goods arguably captures more accurately the concerns surrounding offshore outsourcing of services, it is unclear whether the insights gained from such modeling are unique. In particular, it has long been acknowledged that changes in terms-of-trade that accompany globalization can harm some countries while helping others (Jones, 2006). It has also been recognized that offshoring can be equivalent to factor-augmenting technological change, and that the latter can result in relative wage and price changes that have ambiguous effects on the distribution of income within countries. Put slightly differently, while factor prices are assumed to remain unchanged in H-O type comparative advantage models, the implications of terms-of-trade effects have been extensively discussed in the older literature. Furthermore, the potential productivity impacts of offshoring have been acknowledged and incorporated into more traditional comparative advantage-based models of trade (Bhagwati, Panagariya and Srinivasan, 2004).

In this context, Jones (2006) and Bhagwati, Panagariya and Srinivasan (2004) argue that offshore outsourcing is fundamentally a trade phenomenon, and that subject to the usual theoretical caveats and practical responses, offshore outsourcing results in gains from trade. Furthermore, the effects of offshore outsourcing on jobs and wages are not qualitatively different from those of international trade in goods.

4.1.2 Other Determinants of Trade

It has also been argued that traditional trade models fail to capture the importance of changes in technology that affect transportation and communications. Such changes are suggested to underlie the growth of production fragmentation and, in particular, the offshoring of services. As Baldwin (2009), among others, argues, the geographical separation of various production stages became more economically attractive as it became less costly to co-ordinate complex tasks across geographic distances. Reductions in direct and indirect costs of coping with geographic distances are largely owing to cheaper and more reliable telecommunications, information management software and increasingly powerful personal computers. These developments radically diminished the difficulty of organizing group-work across physical distances, so that stages of production can be dispersed without dramatic reductions in efficiency or timeliness.[8]

It seems fair to argue that traditional trade models do not focus on the role played by changes in technology as they specifically affect the costs and related difficulties of organizing group-work across geographic distances; however, the impact of trade liberalization initiatives is a key feature of traditional trade models, and reductions in effective communication and transportation costs might be seen as being equivalent to

[8] Government policies reducing trade barriers also promote production fragmentation by making exporting and importing more profitable when carried out on a larger scale, thereby reducing in importance the discouraging impact of fixed and sunk costs associated with buying and selling internationally. For a rigorous discussion of this point, see Baldwin (2009).

trade liberalization initiatives in reducing costs of exchange over between countries, although reductions in costs of trade resulting from trade liberalization initiatives do not necessarily promote trade between more physically distant partners. In short, the trade-enhancing effects of technological change can be seen as similar to the trade-enhancing effects of reductions in tariff and non-tariff barriers to trade, although the specific impacts of technology on coordination of work-groups do seem to be more relevant to increased trade in tasks, whereas trade liberalization might be more relevant to increased trade in finished goods.

Jones (2006) suggests that a country's communications and transportation infrastructure should be incorporated into trade models by treating infrastructure explicitly as a critical determinant of a country's comparative advantage. For example, he argues that China enjoys good harbors and highways compared to India, while India enjoys good information technology infrastructure compared to China. This contributes to China enjoying an advantage in outsourced manufacturing and India enjoying an advantaged in outsourced services. More generally, improvements in a country's communication and transportation infrastructure enable firms in that country to participate more efficiently in global supply chains which, in turn, facilitates a nation's trade integration with other countries.

4.2 Evidence on Comparative Advantage and Trade in Intermediate Inputs

A variety of studies offer some empirical evidence on the applicability of comparative advantage-based models to the international specialization of production for intermediate inputs. On balance, they support the relevance of those models. For example, Swenson (2007) examines the evolution of overseas assembly programs (OAP) activities between 1980 and 1994. This program encompassed a diverse cross-section of U.S. outsourced imports. Her empirical model examines the factors that influenced whether a country participated in OAP or not. The probability of participation increased with declines in own-country costs or increases in competitor-country costs. Developing country outsourcing assembly responded most vigorously to changes in own country or competitor costs. Cost sensitivity was also higher in industries populated by a wider range of potential country suppliers. Swenson's findings suggest that OAP activities are influenced by the relative costs of different locations which is certainly consistent with the predictions of comparative advantage-based models. She also notes that there is some inertia in outsourcing partner switches which appears to be related to sunk costs of search and investment.

In a similar vein, Kumar, van Fenema and Von Glinow (2009) report the results of a 2006 survey of offshoring in U.S. public and private sector organizations post-2004. They find that the decision to distribute and locate an offshored task depends on differences in production costs at various sites. Cusmano, Mancasi and Morrison (2008) focus on outsourcing of activities by firms in Lombardy, Italy. They find that firms tend to take advantage of factor price differences across countries and regions in their outsourcing decisions. Borga and Zeile (2004) provide results supporting the hypothesis that firms do divide up the production process and locate different stages of that process to take advantage of relative factor-cost differences. Their results also underscore the association of intra-firm trade in intermediate inputs with fragmented production processes and identify that this trade is most prevalent for affiliates located in countries that offer cost advantages. Finally, Beugelsdyk, *et. al.* (2008) using data on trade flows of U.S. MNC affiliates over the period 1983-2003 find evidence indicating higher value chain

disaggregation (vertical specialization) over time, as well as the systematic exploitation by MNCs of factor cost differences across countries.

To be sure, some authors claim to find evidence contradicting the inferences drawn from H-O type models when applied to outsourcing. For example, Bunyaratave, Hahn and Doh (2007) find that education levels and cultural similarity are significant drivers of offshoring location choices. Hence, firms locate offshoring facilities in destinations that are closer in wages to the home country. Other recent studies question the importance of relative cost differences as determinants specifically of the location of R&D and related product design and development activities. For example, Lewin, Massini and Peeters (2009) find that cost-saving opportunities are an important driver for many offshore implementations, but when firms need to support their product development strategies in the face of talent scarcities, labour cost considerations are less important relative to accessing talent elsewhere. They also report that between 1990 and 2003, offshoring of product design projects was driven by the objective of reducing costs and by the need to increase "speed to market"; however, in the post-2003 period, access to qualified personnel emerges as the strongest driver of offshoring product development projects.[9]

It is unclear whether there is a meaningful distinction between "availability" and "relative cost" as a determinant of offshoring of R&D and related activities. Specifically, one can interpret limited availability of scientists and engineers to mean that the supply curve is relatively steeply sloped in the region of current employment, so that the marginal costs of hiring additional scientists and engineers are relatively high. Hence, even if average costs are lower in location A than in location B, the incremental costs of hiring additional scientists and engineers in location A might be higher than the incremental costs of doing the hiring in location B. Since hiring decisions are made at the margin, it is difficult from the available information provided in the relevant studies to conclude that relative cost is not important in outsourcing R&D, even when managers report that availability of scientists and engineers is the key motivation for offshoring.

In summary, while the available evidence is certainly limited, it does not suggest that the increased specialization of international production observed in recent years is also increasingly inconsistent with traditional explanations of the geographic location of production activities. Indeed, no plausible theoretical argument has been made to support an inference that new theories of international production are needed as vertical specialization increases. While there is little empirical evidence on the factors influencing vertical specialization, the conceptual explanations typically offered highlight the role of technological change. As discussed in an earlier section, changes in communications technology that facilitate efficient management of production networks across borders have been especially highlighted, as have improvements in management information systems and other management skills which also contribute to lower coordination costs associated with managing international production networks; however, such changes have been ongoing for decades, even if the Internet itself is a relatively recent phenomenon. If the economic forces contributing to increased vertical specialization are, indeed, evolutionary, there is little reason to believe that "revolutionary" theories are required to explain the GVC phenomenon.

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[9] The claim that "access" rather than cost is the strongest motivator of decisions to offshore higher skilled functions is also found in Manning, Massini and Lewin (2008).

4.3 Evidence on Offshore Outsourcing

As discussed earlier in the report, conventional theory predicts that MNCs will choose to outsource offshored activities if the (presumed) additional transaction costs of outsourcing (relative to internal production) are low relative to the efficiency gains associated with having a specific production activity undertaken by one or more independently owned firms that enjoy firm-specific advantages in that activity. Furthermore, through vertical specialization, the outsourcing firm might itself enjoy increased efficiencies by focusing more of its resources on those activities in which it enjoys firm specific advantages.

There appears to be only a limited number of empirical studies that directly or indirectly test the relevance of the transaction cost model to offshore outsourcing. The seeming challenge to conventional theory in this regard is that offshore outsourcing is no longer concerned with specialized, repetitive tasks. Rather, offshore outsourcing has grown to encompass a wide range of activities, including "sensitive" functions and knowledge-intensive activities such as R&D and product design. Nevertheless, Cusmano, Mancasi and Morrison (2008) remark for a sample of firms in the Lombardy region of Italy that the conventional inferences from the transaction cost framework are supported by the behaviour of their sample of firms. Specifically, they observe the emergence of loose networks of firms when transactions do not entail complex tasks and can be governed by well codified procedures; however, "tighter" ties among firms tend to be present, including sourcing to foreign affiliates, when tasks are complex and/or no "reliable" partners are present. Furthermore, they find that offshoring of R&D and design activities are positively associated with product innovation and innovation performance when the offshored activities are carried out by a member of the same corporate group as the outsourcer.

Similarly, Lewin, Massini and Peeters (2009) report that owing to concerns about a possible loss of control over strategically important activities, most companies offshoring product activities favor offshoring through a fully owned affiliate, although the importance of controlling product design activities through captive organizations is declining in recent years. The latter phenomenon appears to be the result of innovations in corporate management which facilitate better organization and administration of product design projects carried on outside the organization, as well as the growth of specialized firms offering innovative and specialized services or, equivalently, the growing potential for economic benefits associated with outsourcing product design services holding transaction costs constant. Mankiw and Swagel (2006) discuss the possibility that improved technology and improved legal institutions and governance in foreign destinations are also encouraging offshore outsourcing of more "complex" activities.

5. Suggested Policies Toward GVCs and Offshore Outsourcing

The evidence reviewed in this report suggests that there is no basis for arguing that new theories are required to understand patterns of international production given greater specialization of value chain activities. In particular, the role of comparative advantage-based specialization of production and comparative advantage-based trade continues to be relevant to understand patterns of production for GVCs. If anything, acknowledgement that non-traditional determinants of comparative advantage, particularly communications infrastructure and computer-enabled MIS systems, are becoming more relevant might usefully enhance traditional trade models.

Notwithstanding the empirical evidence, some continue to argue that conclusions with respect to gains from specialization and trade may need to be revised in light of specialization of GVC activities. Most of the concerns raised about the potential adverse consequences of the growth of GVCs are not new. In particular, concerns that higher value-added activities with their associated desirable jobs will be relocated offshore by MNCs are long-standing and are not unique to the offshoring of ever more specialized value chain activities. Specific concerns about R&D activities being indirectly moved outside the home country are also long-standing in Canada. The phenomenon giving rise to this concern in the past was the acquisition of Canadian-owned companies by foreign-owned companies. Such acquisitions were seen as triggering the truncation or elimination of R&D activities in the acquired company in favour of carrying out those activities in larger R&D facilities in the acquiring firm's home country (or other large) affiliate.

Given the extensive literature that has accumulated over time focusing on public policy concerns about the geographic relocation of production activities by MNCs, it is important to assess whether the emergence and growth of GVCs raises public policy issues that are not addressed, or inadequately addressed, in this literature. Put specifically, why should the gains from international specialization of production, accompanied by trade, be compromised by increased vertical specialization of production? Critics merely point to the loss of high-paying white collar positions, but this is the same objection to specialization and trade that has been raised with regard to the loss of high-paying manufacturing employment. In the latter case, manufacturing employment losses in developed countries have been more than offset by the growth of even higher-paying service jobs.[10] In this regard, there is no theoretical or empirical basis to argue that offshoring R&D and related employment will not be offset by a growth of even higher – paying human-capital intensive jobs in developed countries, including Canada. Any argument for policy intervention to discourage the offshoring of specialized production activities must look elsewhere for its justification.

5.1 Reconsidering Public Policy Towards Offshoring

While carefully articulated arguments about new threats to domestic economic prosperity associated with outsourcing are difficult to identify in the literature, the heart of any such argument seems rooted in the relatively long-standing concern about weakening the innovative capacity of the home country. In particular, two specific concerns about outsourcing higher value-added production activities can be identified: 1. to the extent that product design, R&D and other knowledge-intensive activities are partly or wholly separated from other value chain activities and then offshored, technology spillovers associated with domestic innovation activities may be reduced. As a consequence, even though there are efficiency gains to international specialization, the loss of domestic technology spillovers might attenuate those efficiency gains by reducing domestic innovation; 2. innovation and production "clusters" in affected industries will be weakened if specific value chain activities are segmented and offshored. The notion here is that agglomeration economies are a major contributing factor to productive clusters, and agglomeration economies, in turn, arise from the geographic concentration of heterogeneous skilled professional and technical workers.

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[10] Yan (2006) finds that the purchase of foreign intermediate inputs by Canadian firms leads to a fall in the demand for unskilled labour in Canada but an increase in the relative demand for skilled labour.

Both technology spillovers and agglomeration economies are examples of external economies of scale that are associated with industrial and service clusters. Hence, both observations emphasize the potential for the offshoring of specialized value chain activities, particularly R&D, product design and product development activities to lead to a loss of efficiency in the domestic economy owing to foregone external economies of scale; however, as noted above, if offshoring (directly or indirectly) facilitates the importation of more efficiently performed product design and development "services", as well as other inputs to the value chain activities retained in the domestic economy, then the efficiency of those latter activities might actually increase.[11] In particular, offshoring might facilitate international technology spillovers that benefit domestic producers in various domestic value chain activities.

In this context, the policy issue surrounding current offshoring activities is similar to concerns raised about "importing" technology rather than encouraging domestic R&D and related activities through subsidies and other public policies. The basic issue is whether the anticipated net (of social costs) gains from domestic technology spillovers associated with R&D performed in the home country outweigh the anticipated efficiency spillovers (net of social costs) from utilizing technology produced abroad, presumably more cheaply or of "higher quality."[12] The fact that the issue is focused on R&D and product development related to intermediate inputs rather than final goods would not seem to make the issue unique to the discussion surrounding GVCs. Hence, there is no obvious basis for arguing that the GVC phenomenon requires a new perspective on the basic policy questions of whether and by how much should government subsidize domestic innovation activities. There is also no obvious basis for arguing that the GVC phenomenon requires a new perspective on the offshoring of specific activities by Canadian MNCs. In short, the evidence, to date, suggests that the geographic specialization of production undertaken primarily by MNCs has been efficiency-enhancing for host and home countries, and there are no compelling theoretical or empirical grounds to argue that this conclusion is less reliable as vertical specialization by MNCs deepens. This is especially true in the case of small countries such as Canada where domestic "terms-of-trade" for intermediate inputs are unlikely to be affected by how much insourcing or outsourcing of those activities is done by Canadian companies.[13]

5.2 Is Offshore Outsourcing Harmful to the Home Economy?

If it can be agreed that offshoring is likely to improve economic efficiency for home and host countries, a specific question arising is whether the efficiency gains are likely to be attenuated if offshoring of GVC activities is done through outsourcing? Goldfarb (2004) summarily dismisses the relevance of drawing distinctions between the two modes

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[11] For some evidence that the stock market assigns a positive value to firms' announcements that they are initiating global product design and development strategies, see Ojah and Monplaisir (2003).

[12] Technology from abroad will often be embodied in intermediate imports that are imported. For evidence of the empirical relevance of this phenomenon, see Goldberg, *et. al.* (2009) and Kugler and Verhoogen (2009).

[13] The terms of trade argument basically maintains that outsourcing by individual firms might, in the aggregate, lead to higher prices for imported (outsourced) intermediate inputs, as aggregate import demand for those inputs increases. In effect, a pricing externality is created as individual firms seek to lower costs through importing intermediate inputs but, in so doing, they contribute to increased prices of those inputs for importers as a whole.

of outsourcing in asserting that the economic results from intra-company trade are likely to be the same as those from arms-length transactions; however, an argument might be made that offshore outsourcing leads to a "leakage" of technology to foreign-owned competitors of Canadian firms that is less likely to occur when offshoring technology-related activities is done within Canadian MNCs.

The technology leakage argument is also not a new one. Indeed, it was raised in the context of early joint-ventures between North American car manufacturers and Japanese car manufacturers. Specifically, the view of some experts was that North American companies would effectively make expertise available to Japanese companies which, in turn, would enable Japanese manufacturers to become more formidable competitors sooner than would otherwise have taken place. It is difficult to assess this argument with confidence, since it assumes a counter-factual which cannot be tested. Namely, that Japanese companies would not have become the formidable competitors they became had those early joint ventures not been entered into by North American companies.

In the absence of compelling evidence to the contrary, it seems reasonable to assume that Canadian companies that voluntarily enter into offshore outsourcing arrangements, including those involving R&D and other innovation-related activities, do so because they view the arrangement as the most efficient alternative for their companies. While this might not always prove to be the case *ex post*, it is difficult to justify the imposition of public policies restricting specific types of offshore outsourcing based on a presumption that companies will be systematically incorrect in their assessment of the private benefits of offshore outsourcing; however, one might invoke an argument that any leakage of technological and managerial expertise that does occur harms both the firm doing the outsourcing and those domestic firms that do not outsource. The idea here is that the leaked knowledge and/or expertise weakens the competitive position of other Canadian firms besides the firm doing the offshore outsourcing and might thereby lead to reduced income levels of Canadian factors of production. In effect, the leakage of technology and expertise could inflict broad-based negative externalities on the Canadian economy.

Whatever the practical relevance of this (negative) externalities concern, it is not clear that it justifies direct government intervention into offshore outsourcing activities. Indeed, it is difficult to make a persuasive case for such intervention. For one thing, there might well be positive externalities to offshore outsourcing which more than offset any negative externalities overall. For another, it would be impossible, as a practical matter, for governments to assess which specific offshore outsourcing initiatives give rise to negative externalities of the type described above. The only practical policy would be to use policy instruments such as taxation to discourage all offshore outsourcing which would arguably be extremely costly to domestic efficiency.

5.3 Re-assessing the Overall Policy Framework

A number of authors have argued that while the emergence and growth of GVCs can be a source of improved efficiency for Canadian firms involved in international business, public policies should be modified or reshaped to ensure that Canadian firms will fully benefit from the GVC and offshore outsourcing phenomena.

In fact, most of the specific policy suggestions that can be identified overlap traditional policy prescriptions for governments to implement in order to leverage gains from international trade. In particular, governments are seen as having a legitimate and valuable role to play in promoting the legal, physical and educational infrastructure of the home country which, in turn, facilitates efficient domestic production and the ability of

domestic firms to engage in international trade. Yip (2007) is a prominent example of a GVC strategy expert who puts at the top of his list of things that governments need to do to attract value chain activities traditional policies that have been identified as promoting a countries ability to engage efficiently in international trade, as well as attract inward FDI. Specifically, at the top of his list are: 1. good infrastructure; 2. access to transportation and (air) ports; 3. skilled workers. More controversial, perhaps, are the other items he highlights which include low taxes and "easy conditions of employment."

Treffler (2008) asserts that many Canadian firms have yet to recognize the sea change in their sourcing possibilities. Nor do they adequately understand that offshoring will enable them to concentrate on core activities which will improve their efficiency and competitiveness. He argues that better information about strategic offshoring options is needed by Canadian firms. While Treffler does not explicitly call for government policies to rectify the information gap he identifies, it seems fair to presume that it is an implicit call for appropriate public policies; however, it is unclear why governments would have more information than private sector firms about the strategic benefits and options surrounding outsourcing. Less controversially, Trefler calls for domestic public policies that encourage investment in upgrading and innovation by individuals (i.e., human capital) and firms (R&D).

Other suggestions have focused specifically on improving the capabilities of domestic firms (particularly small and medium-sized firms) to participate in GVCs. Many of the specific suggestions involve actions that must be initiated by the domestic firms themselves. One such suggestion is that companies work to establish stable and sustainable relationships with "high-performance" partners that have the ability to make substantial contributions to value chain activities ranging from product design to customer service (Krywulak and Kukushkin, 2009). Another is that firms improve their abilities to coordinate and manage value chains involving multiple partners, as well as participate in GVCs. Specific attributes highlighted in this regard are a firm's financial stability, compliance with industrial standards and certifications, production capacity, flexibility and electronic capability (Krywulak and Kukushkin, 2009). Again, while these suggestions seem quite reasonable, it is unclear what public policy implications follow from them.

Perhaps the broadest public policy implication one might draw from the recent literature on GVCs is that the Canadian government's role in facilitating the freer international flow of goods, services, capital and people is still extremely important, since a "thicker" Canadian border clearly reduces the attractiveness of Canadian companies as GVC partners. In this regard, recent concerns that border security and related measures put in place after 9/11 have thickened the Canada-U.S. border and, perhaps, also increased trade costs between Canada and other trading partners merit serious attention and remediation.[14] While U.S. government policies are certainly a major contributor to border thickening between Canada and the U.S., the challenge facing the Canadian government is to encourage changes in U.S. government policies that unduly increase the costs of bilateral trade and investment, particularly when those policies are motivated primarily by domestic protectionist pressures in the United States. In a broad sense, this too represents more of a continuation of long-standing Canadian public policies than any new direction for policy arising from the growth of GVCs and offshore outsourcing.

[14] For some discussion of a possible thickening of the Canada-U.S. border, see Globerman and Storer (2008) and Hodgson (2008), among others.

6. Summary and Conclusions

In summary, the offshoring and outsourcing phenomena are largely consistent with established theory that has guided public policy essentially since the initiation of the GATT Round of trade liberalization. In particular, increased vertical production and trade specialization are efficiency enhancing for both home and host countries, as has been empirically established for production and trade specialization in the case of finished and semi-finished products.[15] Furthermore, and notwithstanding the enormous recent attention being paid by academics and policy analysts to the GVC and offshore outsourcing phenomena, it is not at all obvious that the growth of these phenomena change public policy imperatives in any significant way. Specifically, the appropriate broad roles of government continue to be investing in social infrastructure capital (both physical and human), ensuring that the legal and regulatory environments of Canada are conducive to efficient economic production while meeting social needs related to public health and safety, and continuing to negotiate liberalized trade and investment conditions with Canada's international trading partners.[16]

It might be argued that increased international vertical specialization necessitates "finer grained" public policies. For example, while tax rate differences at the national level have not been found to be consistently important determinants of foreign direct investment flows at the aggregate or industry levels, the location of specific value chain activities might be significantly affected by differences in tax rates across countries and regions. In fact, there is little available empirical evidence on the determinants of the geographical location of specific value chain activities. Furthermore, since firms are ordinarily taxed on the basis of their profits, it is unclear whether one can meaningfully discuss tax policy at the level of the individual value chain activity. As a general matter, the "conventional wisdom" with respect to corporate tax rates would seem to apply whatever the degree of specialization of production that multinational companies undertake. Namely, higher tax rates that are not offset by (direct or indirect) productivity – enhancing public services make a location less attractive to investors, all other things constant.

To be sure, it would be useful to know more about the determinants of GVCs and offshore outsourcing activity, particularly from a Canadian standpoint, both to strengthen the tentative conclusions drawn in this report, as well as to identify whether public policy priorities are changing as a result of increasing vertical specialization and outsourcing. Research in this area might be particularly helpful in ensuring that infrastructure and related policies at the federal and provincial government levels are complementary. In particular, the importance of technology clusters as a magnet for corporate investment has been amply documented in the literature. Competition amongst provinces to create clusters meant to attract similar types of value chain activities in the same industries is likely to be wasteful and even self-defeating, as scarce domestic resources are spread thin across geographic locations within Canada. Hence, government expenditures on physical and social infrastructure should be guided, at least in part, by the location advantages of regions within Canada with respect to specific activities within particular industries.

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[15] Treffler (2005) concurs that the available evidence supports a conclusion that offshoring leads to higher productivity, although he cautions that we have little hard evidence of the relationship for technology-intensive industries.

[16] Barriers to internal labour market mobility, such as provincial licensing restrictions for professionals, also attenuate labour market adjustments that enhance the net benefits of offshore outsourcing.

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Integration of the North American Economy and New-paradigm Globalization*

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1. Introduction

Since the dawn of human civilization, the cost of moving goods, people, and ideas has forced the geographical bundling of economic activity. Before the days of easy shipping, communities were obliged to consume what they could make. The gradual reduction of shipping costs, with acceleration from roughly 1850 onward, meant that factories did not have to be near consumers, and competitive pressures pushed production toward the most efficient locations. This first "unbundling" brought about many wonders of the modern world. Nations (and regions within nations) started to specialize in the production of certain goods. Large cities arose and the concentration of talent and know how fostered further innovation and scale economies; the Industrial Revolution was born along with the rise of mass intranational and international trade. Up to the mid-1980s, unbundling operated at the level of factories or even whole industries since it was economical to keep all manufacturing stages in close proximity.

Since about the mid-1980s, rapidly falling communication and co-ordination costs have fostered a second unbundling – this time of the factories themselves. Cheaper, higher quality and more reliable communications reduced the need to perform most manufacturing stages near each other. As with the first unbundling, changing technology opened the door to spatial separation and competitive pressures pushed industry across the threshold. Even more recently, the second unbundling has spread from factories to offices with the result being the outsourcing and offshoring of service-sector jobs.

It is useful to view the first and second unbundling as being described by two paradigms. The old paradigm – essentially traditional trade theory – was useful for understanding the impact of the first unbundling. Understanding the second unbundling requires a new paradigm – what Gene Grossman and Esteban Rossi-Hansberg called "trade in tasks" in their famous Jackson Hole paper (Grossman and Rossi-Hansberg 2006a). Even though the old and new paradigms happily coexist (factories and consumers continue to be separated even as the factories themselves are unbundled), they have quite different implications for how governments should react to globalization.

As we shall see, the key difference is the level of analysis. In the old paradigm, greater openness tended to affect sectors as a whole and, importantly, the fortunes of sectors tended to be shared with the productive factors used most intensively in the sectors. The

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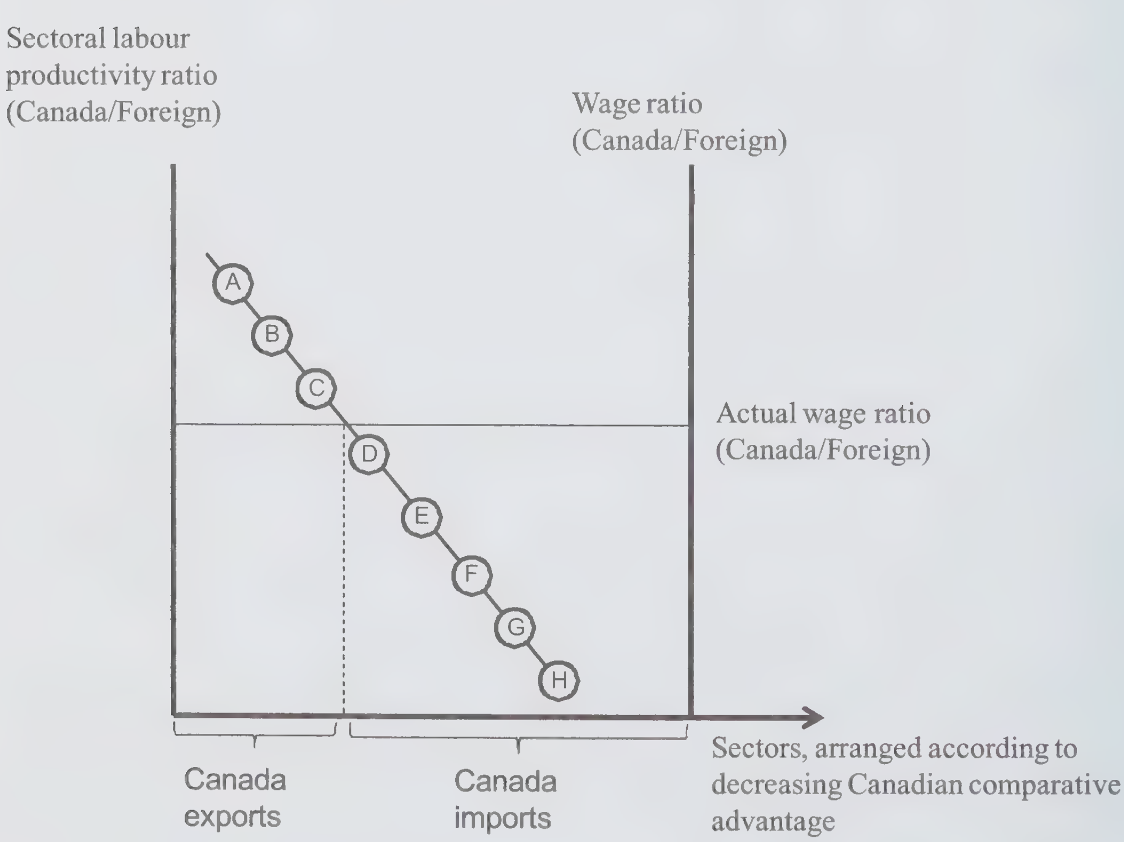
standard level of analysis was thus sectors and labour skill groups. Globalization occurs with a much finer resolution in the new paradigm, forcing a rethink of the policy prescriptions flowing from the old paradigm.

This paper presents the trade-in-tasks conceptual framework and extends it to allow for factors that are critical to the analysis of the development of North American industry (e.g., recognizing that Canada and the United States are both high-income nations while Mexico is not). It also considers the policy implications for the Government of Canada, identifying the policy levers and policy initiatives that should be examined to support the development of North American economic platforms. To accomplish these goals, it is necessary to start with the old paradigm, recasting it in a fashion that facilitates comparison with the new paradigm. This is the job of Section 2. The subsequent two sections respectively introduce the new paradigm (trade in tasks), and then extend it to allow for factors critical to the study of North American integration. The next section, Section 5, discusses the policy implications of the extended trade-in-tasks framework, including the impact of trade facilitation, labour and industrial policies, tariff policies, rules of origin, and product standards.

2. The Old Paradigm

Traditional thinking about globalization – namely standard trade theory – is based on a comparison of nations' competitiveness sector by sector. The goal is to work out a nation's comparative advantage. To think about this, it is useful to start with a fairly abstract view of the competitiveness of a nation's various sectors. Figure 1 facilitates the analysis.

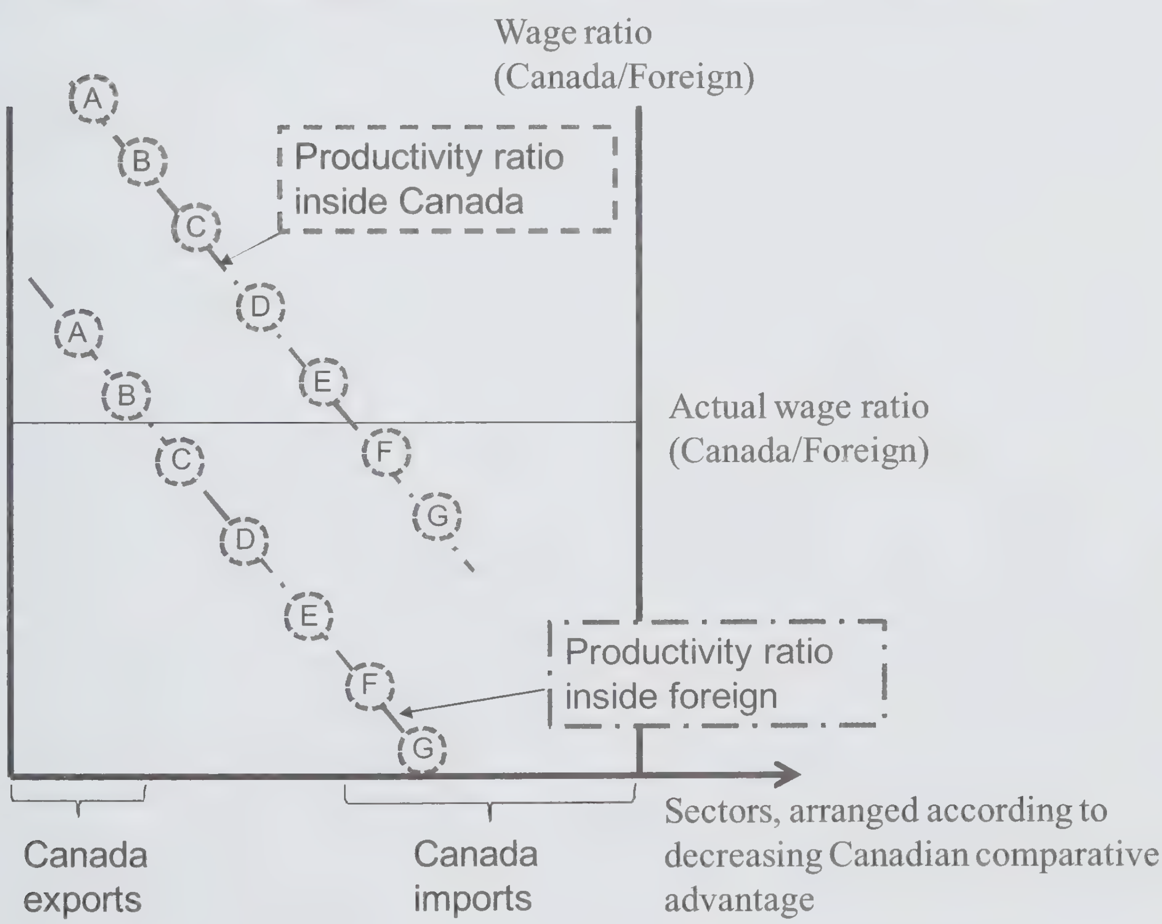
Figure 1: Old paradigm analysis of competitiveness



The diagram lists sectors along the horizontal axis according to their competitiveness. Canada's most competitive sectors are on the left. For instance, the ratio of Canadian to foreign labour productivity is highest for sector A. The least competitive sectors are on the right; e.g., sector H. This measure of competitiveness, however, is incomplete since it does not account for the wage differential. The actual wage gap – i.e., the ratio of Canadian wages to foreign wages – is marked with the flat line. As drawn, Canada's productivity gap more than outweighs the wage gap for sectors A, B, and C. That is, given the actual wage ratio (wage gap) and the productivity ratio (productivity gap), Canada can produce sector A, B, and C goods more cheaply and thus it exports these goods. The other goods are where the foreign market has a comparative advantage. Canada imports these goods.

The Figure 1 analysis ignores transportation and other trade costs. Since changes in such costs are a central character in globalization's drama, we have to modify the diagram to get them into the picture. This is simple, requiring nothing more than the realization that the competitiveness of a Canadian good is different in the Canadian market than it is in the foreign market and vice versa. Specifically, we have to adjust the productivity gap. The cost of Canadian products inside foreign markets will be higher due to trade costs, so Canada's productivity edge will be dampened by trade costs, and the opposite holds for the competitiveness of foreign products inside Canada. We show this in Figure 2 by having two lines representing the labour productivity ratio: one for the ratio inside Canada (where foreign firms face the disadvantage of having to pay transport costs) and one for the ratio inside the foreign market (where it is the Canadian firms that are disadvantaged by the transport costs).

Figure 2: Old-paradigm analysis of competitiveness with trade costs



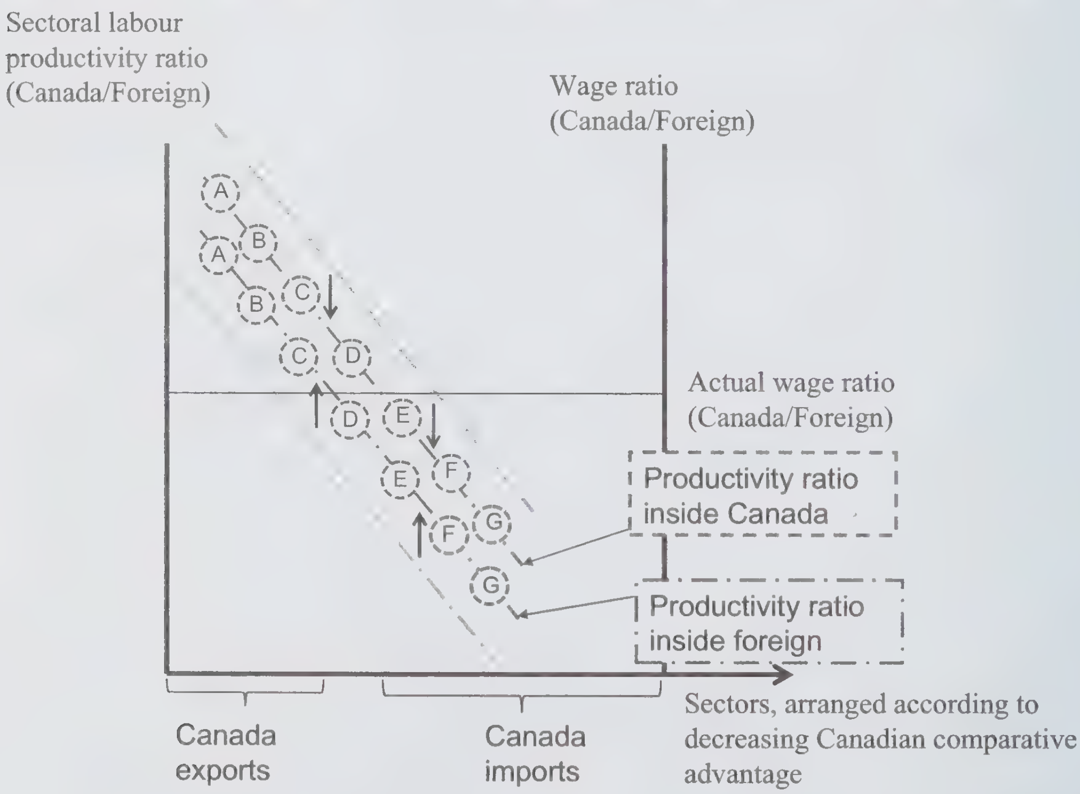
The implications of this are intuitively obvious: some goods will be made in both nations since local producers are more competitive in both markets given trade costs. In other words, there will be non-traded goods. In the diagram we see that product C is above the wage line for sales inside Canada; as usual, this indicates that Canadian firms will be the low-cost producers for the Canadian market. However, product C is below the line in the foreign market, so foreign firms will be the competitive ones in product C in their own market. The same holds for goods D and E, so C, D, and E will be non-traded. Using the bundling terminology, transport costs means that the production and consumption are still bundled nation by nation for these sectors; nations consume only what they make.

By contrast, products A and B are above in the foreign market, indicating that Canada would be the low-cost producer, so Canada exports these; F and G are below inside Canada, so these are the sectors where Canada would be the importer.

2.1 The impact of falling trade costs: The first unbundling

The last thing to do with this old-paradigm construction is the most crucial. We use a diagram to consider the impact of globalization; i.e., lowering trade costs. This is done in Figure 3. As trade costs fall, the two lines get closer since the trade cost is less of a factor in determining competitiveness. Naturally the result is an expansion of trade; consider the pattern of this expansion. Canada now becomes competitive in sector C (the trade cost-adjusted productivity ratio in foreign market is now above the line for C) and so it starts to export this sector. By the same token, the trade cost-adjusted productivity ratio is now below the line inside Canada, so the foreigner becomes competitive and Canada starts to import sector D.

Figure 3: Unbundling in the old paradigm: impact of lower trade costs



2.1.1 Key lessons for old-paradigm policy thinking

While few policy makers would have these diagrams in mind, something like them was very evident in shaping their thinking about globalization, the effects on the economy, and what they as policy makers should do about it.

The key point is that globalization made some of Canada's sectors more competitive and others less so. But which ones? The "winners" and "losers" were not randomly assigned. The new winners from globalization are sectors that are similar to the ones that were already exported. The losers, like sector E, are the sectors that are similar to the sectors where Canada was already uncompetitive.

2.2 The appropriate level of analysis: Sectors and skill groups

A critical implication of this line of reasoning – a line that most policy makers still work with today – is that globalization's impact is rather predictable. Policy makers could and did identify "sunrise" and "sunset" sectors in advance. They felt they had a rough idea of the identities of the winning and losing sectors. After all, the first unbundling essentially exaggerates the existing pattern of comparative advantage.

For example, as the world opened up, Canadian clothing manufacturers lost out to import competition, and as globalization proceeded, this trend deepened. The lower trade costs, however, meant the Canadian natural resource-based and high-tech products gained markets, with the range of such winning sectors expanding as globalization rolled on.

There are a couple of critical assumptions lurking behind this thinking. First, as drawn in Figure 3, it assumes that further globalization lowers trade costs more or less evenly for all sectors. That is, one would not expect a radically different change in the trade costs facing sector D and sector E. Second, the comparative advantage of the sector is roughly related to its factor intensity. For example, it was useful to think of Canada's sunset sectors as marked by unskilled labour intensity, while the sunrise sectors were marked by skill intensity.

2.3 Policy thinking based on the old paradigm

In the old-paradigm thinking, sectors, or at most firms, are the finest level at which globalization's impact was felt. More open trade spurred the fortunes of some firms while spiking the fortunes of others but the sector was the finest level of disaggregation worth looking at. Since most firms in a sector stood or fell together, the type of labour used most intensively in the sector typically shared the sector's fortunes. This led governments to organize their globalization policies around sectors and labour market skill groups. More specifically, the correlation between current competitiveness and the impact of deeper globalization demonstrated in Figure 3 led governments to believe they could predict globalization's future impact on the domestic economy. The sectors that "won" from globalization were the sectors that were already the most competitive ones. The "losing" sectors were the least competitive ones. Going further, one could roughly associate the most competitive sectors with high-tech, human capital-intensive sectors, and the least competitive sectors with unskilled, labour-intensive sectors. In turn, one could roughly associate the winners from globalization as Canada's high-skilled, high-education workers (and those working in natural resource-based sectors); the losers were, typically, low-skilled, low-education workers.

Guided by this old-paradigm worldview, the job of a good policy maker was crystal clear – at least in the abstract. The job is to help the country move resources from the sectors that are likely to lose as the first unbundling continued and shift them into sectors that are likely to win. In the Figure 3 example, the government should be helping to retrain workers who lost their jobs in sector E to become sector C workers. Again roughly speaking, this meant raising skill levels and shifting workers from sunset sectors to sunrise sectors. Skill upgrading, research and development, and support for high-tech industries were but some of the natural policy initiatives that flowed from this thinking.

As we shall see below, the new paradigm introduces a line of thinking that should make governments much more cautious about predictions concerning globalization's winners and losers, and thus more cautious about their optimal policy response.

2.3.1 Diagrammatic analysis of winners and losers

The difference between the old and new paradigms can be made clearer by introducing a simple diagram that helps connects the fortunes of sectors and skill groups. Figure 4 is the diagram.

We start with the left panel of the diagram. Here the wage of unskilled workers, w, is on the vertical axis and that of skilled workers, v, is on the horizontal. For simplicity's sake, there are only two sectors, the Y sector, whose pricing is especially sensitive to the price of skilled labour (since it is skill-intensive), and the X sector, whose price is especially sensitive to unskilled wages. This sensitivity is easy to see. The Y-sector pricing equation shows the combinations of w and v that allow Y-sector firms to match the market price. Plainly, any increase in either w or v must be matched by a reduction in the other if price competitiveness is to be maintained. But note that a small increase in the skilled wage, v, requires a larger decrease in w – that's because Y is skill-intensive. Similarly, X is unskilled labour intensive, so a 1 percent increase in w would require a more than 1 percent drop in v to allow X-sector firms to remain competitive with foreign producers.

The combination of skilled and unskilled wages where both sectors are competitive is marked by the point E; the equilibrium wages are marked as w^o and v^o.

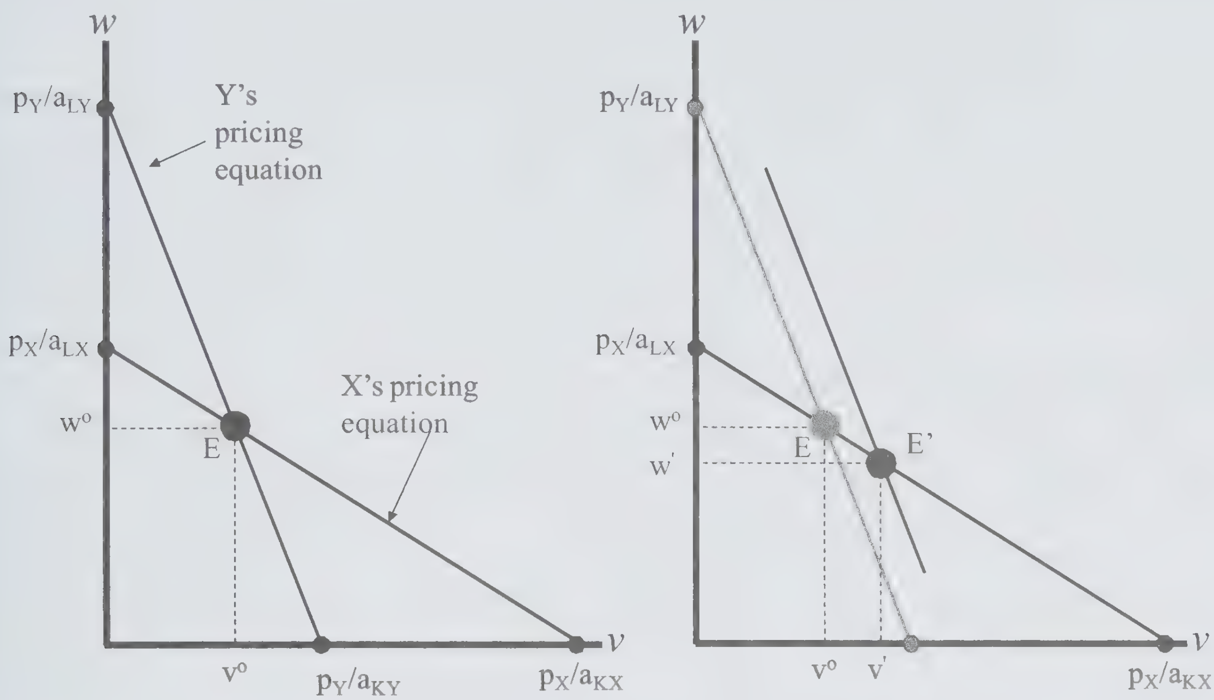
The purpose of the diagram is to allow us to connect the fate of skill groups to the sectors in which they are intensively employed. The left panel does this. In this case, we assume that Y is the export sector, so lower trade barriers, natural and artificial, favour Y. Specifically, as Y-sector firms get better access to foreign markets, the sector adjusts along two dimensions: first, the sector produces and sells more, and second, it sees a higher price net of trade costs.

In the diagram, this favourable export-sector development shows up as a shift out in the Y-sector price line. That is, the sector can now maintain competitiveness even after paying some combination of higher v and/or w. The situation in the import competing sector, the numeraire X sector, doesn't change. This tells us that the w and v must move in opposite directions if both sectors are to remain competitive after the further market opening.

The new intersection, point E', shows the new combination of w and v that allows both sectors to be competitive. The result – a result we foretold with verbal reasoning above – is that the factor used intensively in the export sector gains from globalization while the factor used intensively in the import sector loses.

This, in diagrams, is the correlation between sectoral fates and skill group fates – a correlation that is at the heart of most nations' thinking on the effects of globalization.

Figure 4: Sectors and the fate of skill groups: first unbundling



3. The New Paradigm: Second Unbundling and Trade in Tasks

As manufactures account for 70 percent of global trade, the nature of trade and the nature of manufacturing are inexorably linked. Both the first and second unbundlings fostered and were fostered by radical changes in how things are made.

3.1 Nature of manufacturing, nature of trade, and the first unbundling

Before the Industrial Revolution, manufactured goods were basically handicrafts. One of the most sophisticated 18th century machines – rifles – were constructed one at a time by highly skilled craftsmen using hand tools. The workshops making them were geographically dispersed across nations, roughly in line with the location of consumers; trade flows were modest. In 1801, Eli Whitney came up with the notion of standardizing parts to the extent that they were interchangeable. Rifles could be made faster, cheaper, and with less skilled workers. The resulting gains in competitiveness gave rise to large manufacturing corporations that put many smaller arms makers out of business. The resulting geographical concentration of rifle making separated factories and consumers, spurring long-distance trade (both intra- and international) of the first-unbundling type.

A century later, the Ford Motor Company greatly refined assembly-line mass production. The Ford method was much faster and used less manpower than 19th century manufacturing techniques, but worked best at massive scales of production. This further stimulated first-unbundling trade as the competitiveness of Ford's products forced smaller automotive factories around the world to close – thus increasing the distance between automakers and most auto buyers. The Ford method faced important organizational challenges. To keep things moving smoothly and reliably, producing a car every three minutes, Henry Ford spatially concentrated the production of almost everything. What he couldn't concentrate, he bought so as to better control. He owned rubber plantations, coal mines, and forests as well as the ships and railroad cars that transported them to his plant.

The famous River Rouge plant in Michigan employed about 100,000 workers in the early 20th century.

This hyper concentration came at a cost. It meant that almost every stage of producing a Model T had to be done with labour and capital located in Michigan. There would have been a financial gain from unbundling production stages and locating where factor costs were better suited to each stage's demands, but this was impossible. Co-ordinating complex activities over long distances was impossible at the time. Transportation was slower and less reliable; telecommunications were only for emergencies. To ensure that parts and components were ready when needed, North American labour, capital, and technology were spatially bundled in one place.

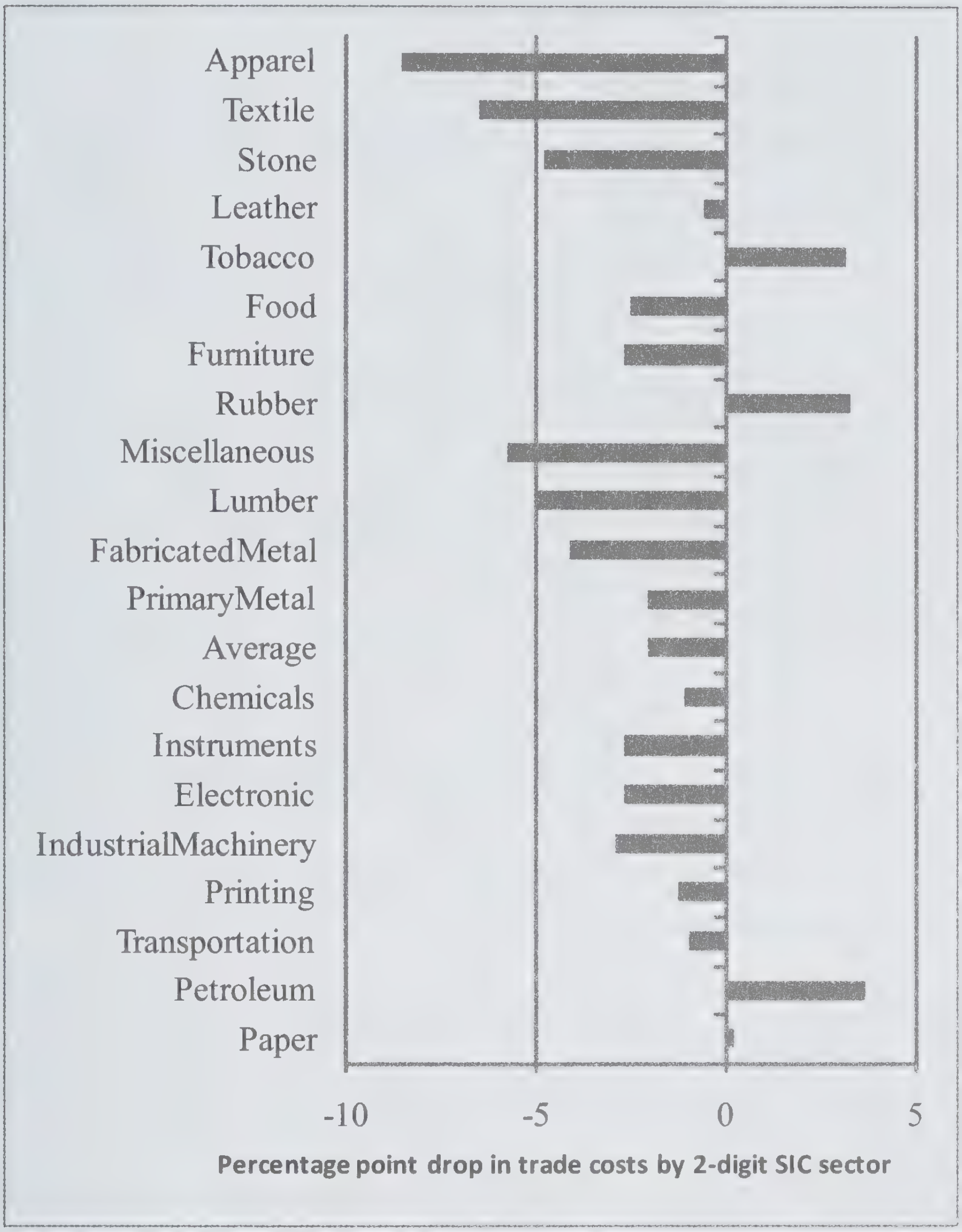
3.2 Unbundling and the co-ordination revolution

Geographically separating various production stages became more attractive as it became less costly to co-ordinate complex tasks across distance. Falling trade costs – the combination of lower tariffs and lower freight costs – played some role, but not a dominate one (Hummels 2007). As Figure 5 shows, trade costs (the combination of freight rates and tariffs) did fall in this period, but for most sectors the reduction was less than 5 percent from 1982 to 1992. Regular surface shipping did not get much cheaper but the growing density of shipping lines made surface shipping easier and more reliable. The price of air cargo fell, but again not spectacularly (WTO 2008).

More important are advances in information and communications technology (ICT) in explaining the dramatic drop in the cost of organizing complex activities over distances. This showed up in many ways. The price of an old-fashioned telephone call plummeted, along with regulation, computing costs, and the cost of fibre optic transmission rates. New forms of communication appeared and rapidly transformed the workplace. Faxes became standard equipment. Cellular phone usage exploded. The telecommunications network also became denser and more reliable as it became cheaper. Above all, the Internet – first e-mail and then web-based technology – revolutionized the sharing of information over distance. In 1984, there were 1,024 Internet hosts in the world; by 1995, the number was 6.6 million, rising to 106.8 million in 2000.

Interacting with cheaper communications costs was the spectacular fall in the price of computing power. Things that required a Cray super computer in 1984 could soon be performed on a high-powered PC. This encouraged the development and widespread use of information-management software (ranging from spreadsheets to sophisticated database programs). Cheap and reliable telecommunications, combined with information management software and desktop computers to run them, completely transformed the difficulty of organizing group-work across space. Stages of production that had to be performed in close proximity – within walking distance to facilitate face-to-face co-ordination of innumerable small glitches – could now be dispersed without an enormous drop in efficiency or timeliness. Working methods and product designs were also shifted in reaction to the spatial separation, typically in ways that made production more modular.

Figure 5: Drop in trade costs 1982-1992 by SIC sector



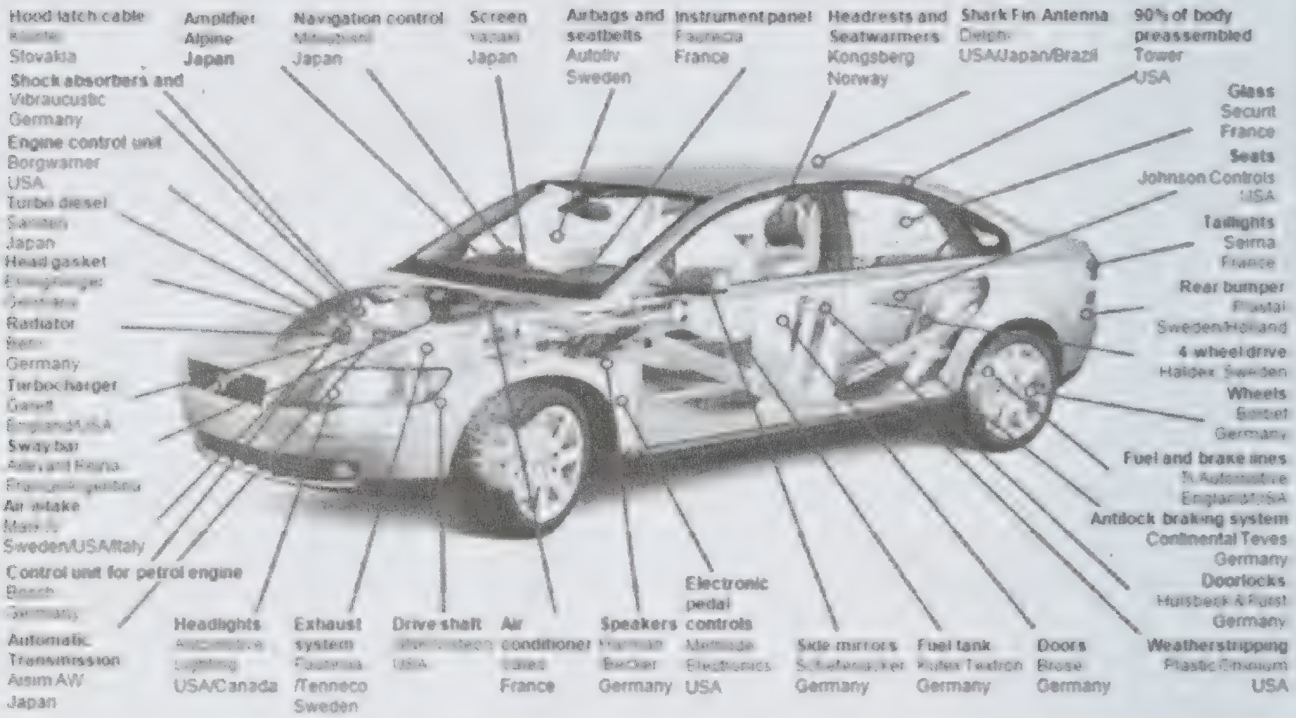
Source: Bernard, Jenson, and Schott (2003), Table 1

The second unbundling is a result of this lower communication costs. Things that had to be done in various bays in the same factory in order to reduce delays due to miscommunications could now be done in separate factories located far from each other. In essence, the production bays became their own factories and were dispersed to locations that had factor prices and other characteristics better suited to the particular needs of the production stage.

An example of the second unbundling can be seen in Figure 6. This shows where the parts of the "Swedish" Volvo S40 are made. The navigation control and screen is made in Japan, the side mirror and fuel tank in Germany, the air conditioner in France, the headlights in the United States and Canada, the fuel and brake lines in England, the hood latch cable in Germany. Some parts are even made in Sweden (airbag and seat belts). These "parts" are themselves made up of many parts and components, whose production location is likely to be equally dispersed. For example, the air conditioner will have to have

a compressor, motor, and a control centre, each of which may be made by a different company in a different nation.

Figure 6: Where are the components of the Volvo S40 made?



Source: Baldwin and Thornton (2008), taken from a presentation by Ericsson, Chairman Michael Treschow.
Note: Thanks to Shon Ferguson for translation from Swedish.

The diagram makes clear that Henry Ford's spatial concentration of production is finished. Manufacturing stages that used to be done by the same company in the same factory are now dispersed around the world. Sometimes these are owned or controlled by the original manufacturer, but often they are owned by independent suppliers.

It is important to note that many of these international supply chains are regional, not global. The cost and unpredictable delays involved in intercontinental shipping still matters. Moreover, co-ordination in the same time zone is easier and more reliable. An additional factor that has fostered regionalization over globalization is the fact that the cost of moving key managers and technicians has not fallen radically. Even if airfares have come down, the opportunity cost of the managers' time has actually risen. If a Canadian firm puts a factory in Mexico, the manager may have to spend a whole day to hold a one-hour face-to-face meeting. If the factory is in China, the time cost will be more like one whole workweek.

The first large-scale production unbundling started in the mid-1980s and took place over very short distances. The maquiladora program created "twin plants," one on the US side of the border and one on the Mexican side. Although the program existed since 1965, it only boomed in the 1980s, with employment growing at 20 percent annually from 1982 to 1989 (Federal Reserve Bank of Dallas 2002, Feenstra and Hanson 1996). Another second unbundling started in East Asia at about the same time (and for the same reasons). In this region, distances are short compared with the vast wage differences (Tokyo and Beijing are about 90 minutes apart by plane, yet in the 1980s the average Japanese income was 40 times the Chinese average). In Europe, the second unbundling was stimulated first

by the European Union (EU) accession of Spain and Portugal in 1986, and then by the emergence of Central and Eastern European nations.

3.3 The trade-in-tasks conceptual framework

To organize our thinking about the second unbundling, it is useful to explain the basic determinants of whether a particular task is performed at home or abroad. This is not difficult as it boils down to cost savings. Consider a task that requires some skilled and some unskilled labour. If the firm organizes production such that the task is performed domestically, then the cost of the task will be:

$$\begin{pmatrix}\text{Domestic}\\ \text{task}\\ \text{cost}\end{pmatrix} = \begin{pmatrix}\text{Domestic}\\ \text{unskilled}\\ \text{wage}\end{pmatrix}\begin{pmatrix}\text{Domestc}\\ \text{unskilled}\\ \text{requirement}\end{pmatrix} + \begin{pmatrix}\text{Domestic}\\ \text{skilled}\\ \text{wage}\end{pmatrix}\begin{pmatrix}\text{Domestic}\\ \text{skilled}\\ \text{requirement}\end{pmatrix}$$

The cost of the task if the firm buys it from abroad would be quite similar but note that now foreign wages and foreign input requirements would be used. There are also additional costs that would arise from co-ordinating the production with one of the tasks taking place far away:

$$\begin{pmatrix}\text{Foreign}\\ \text{task}\\ \text{cost}\end{pmatrix} = \begin{pmatrix}\text{Foreign}\\ \text{unskilled}\\ \text{wage}\end{pmatrix}\begin{pmatrix}\text{Foreign}\\ \text{unskilled}\\ \text{requirement}\end{pmatrix} + \begin{pmatrix}\text{Foreign}\\ \text{skilled}\\ \text{wage}\end{pmatrix}\begin{pmatrix}\text{Foreign}\\ \text{skilled}\\ \text{requirement}\end{pmatrix} + \begin{pmatrix}\text{Offshoring}\\ \text{costs}\end{pmatrix}$$

The last terms encompass all manner of co-ordination and trade costs.

In the trade-in-tasks framework introduced by Gene Grossman and Esteban Rossi-Hansberg at the Jackson Hole conference in 2006, the key determinant of unbundling is the cost of performing each task at home or abroad. In one version of their theory, they allow firms to use home-country technology when employing foreign workers abroad. In this case the "Foreign task cost" involves foreign wages, but "Home" labour requirements – a factor that has interesting implications for research and development (R&D) policy (Section 5).

3.3.1 Determinants of offshoring costs: Unpredictability

It is not a random outcome that the production of goods and services is undertaken in factories and offices throughout the world. Spatially clustering production stages – i.e., packaging tasks in offices and factories – is done to make it easier and cheaper to produce what the firm sells. The problem is that economists really do not understand the "glue" that binds production stages and tasks together. The standard approach, production functions, is a black box; one assumes that certain amounts of productive factors are combined to produce a certain amount of output. Given this lack of modelling – to say nothing of a lack of empirical work in the area – economists cannot really pretend to understand how expensive it would be to offshore various bits of a production process. Worse yet, the problem cannot really be considered task by task since the offshoring of some tasks will typically change the cost of offshoring other tasks.

For example, consider a "team" of tasks that is spatially clustered in a single office. To be concrete, say there are n tasks – each performed by one worker – that must be performed to produce the intermediate input (say a marketing report), which is itself fed into a larger production process. Co-ordinating the n tasks requires each worker to talk, say, once a day with every other worker. Turning to offshoring possibilities, assume that offshoring entails a fixed cost per task offshored, and that each of the tasks could be performed more cheaply in India.

But what about co-ordination costs? Talking face-to-face is more efficient in terms of time than e-communicating. Keeping all the tasks in the same office reduces co-ordination costs, but this is true whether the office is in Canada or India. In particular, co-ordination costs are maximized when half the tasks are done in India and half in Canada. Now what this means is that wage savings plus extra co-ordination cost may not make offshoring one task worthwhile. However, if the co-ordination cost among a group of tasks falls, the offshoring decision can face a tipping point. Offshoring of tasks happens in a lumpy fashion. In this simple example, no tasks are offshored for all co-ordination costs up to a certain level, but beyond that point, all tasks are offshored.

Another key source of unpredictability could come from cluster economies. In both services and manufacturing, tasks are subject to backward and forward linkages. That is, there is a tendency to cluster certain tasks together spatially to improve efficiency and gain better access to customers. In this sort of world, the international allocation of tasks can be subject to multiple equilibria with the possibility that small changes can shift the economy between these equilibria. For example, it could be that few tasks are offshored since the local production of these tasks creates agglomeration economies that make local production competitive. However, if enough tasks get offshored to erode the agglomeration economies, all the rest of the tasks may also then be offshored.

The range of possibilities is quite large, as policy analyses in the new economic geography show (see Baldwin et al. 2003). When agglomeration economies are important, marginal changes can lead to very large shifts.

3.3.2 Is trade in tasks good or bad?

In 2004, Greg Mankiw, who was then Chairman of the US Council of Economic Advisers, announced to the US business media that offshoring was just like trade in goods: "More things are tradable than were tradable in the past, and that's a good thing" (as cited in Blinder 2006, p. 113). Mankiw was in good company since trade theorists have long modelled the second unbundling, fragmentation, as if it were just like trade in new goods.[1]

A central insight in the Mankiw offshoring literature is that one can think of offshoring as technical progress in final goods. The intuition is dead easy. Unbundling production processes – allowing trade in intermediate goods and services – opens new opportunities for arranging final-good production more efficiently. The extra opportunities must mean that the same quantity of primary resources can produce a higher value of final goods. That, of course, is just the definition of technological progress in final goods, and this is why offshoring tends to act like technological progress in final goods.

[1] For example, Dixit and Grossman (1982), Ron Jones and co-authors (Jones and Findlay 2000, 2001; Jones and Kierzkowski 1990, 2000, 2001; Jones and Marjit 1992); Deardorff (2001a, 2001b), Venables (1999), and Markusen (2005). These papers present a bouquet of special cases in which many expected and unexpected things can happen. For an even older tradition, see Batra and Casas (1973).

While the productivity improvement is guaranteed at the global level, national gains are subject to the usual provisos concerning terms of trade, factor intensive reversals, etc. This ancient insight is very helpful in placing offshoring models in the broader context of trade theory.[2] It is also a useful way to explain the potential gains from offshoring to non-specialists.

A second central insight in the Mankiw offshoring literature concerns the impact of offshoring on wages. In general, the literature concludes that there is nothing that can be said in general. The impact depends upon the factor intensity of the offshored task and the factor intensity of the sector doing the offshoring. The point of these results was to dispel the common perception that offshoring the production of labour-intensive goods to low-wage nations definitely harms low-skilled workers in the offshoring nation.

The fundamental economic logics of these two key insights are considered in turn.

3.3.3 Offshoring as technical progress

The core economic logic of the offshoring-as-technical-progress insight can be most directly illustrated in a very simple framework where there are no gains from trade in final goods. That is, there are two nations, but only one final good and only one factor of production: labour. The production of the final good involves two stages or "tasks."

To study the welfare effects of Mankiw offshoring, it is useful to introduce the standard Ricardian diagram where there are two types of tasks (task 1 and task 2), one final good, and two nations, as shown in Figure 7. As usual, the total amount of the tasks that can be produced by each nation is shown with the production possibility frontier (PPF) for Home and Foreign. The tasks, however, cannot be directly consumed; they are combined into the single final good. Graphically, this is shown as an "isoquant"; i.e., the combination of task 1 and 2 that can make a given amount of the final good.

To see how much Home makes without trade in tasks, we search for the highest isoquant that respects Home task-production constraint, namely the PPF. The answer is at point A in the left panel. Note that:

- A similar exercise reveals that Foreign would be at point A* without trade in tasks.
- The implicit prices of task 1 and 2 in Home and Foreign are set in their local markets and equal to the slopes of their respective PPFs.
- There would be no trade between these nations since wages would adjust to make each nation equally competitive in producing the final good.

When trade in tasks becomes possible, nations can trade the two intermediate tasks 1 and 2 as well as final good X. This situation is described by the right panel where the world PPF, marked PPF_w, becomes the relevant constraint on the production of final good X. (For simplicity, we assume away trade costs for tasks and goods in the diagram, so this is a switch from prohibitive task-trade costs to zero task-trade costs.)

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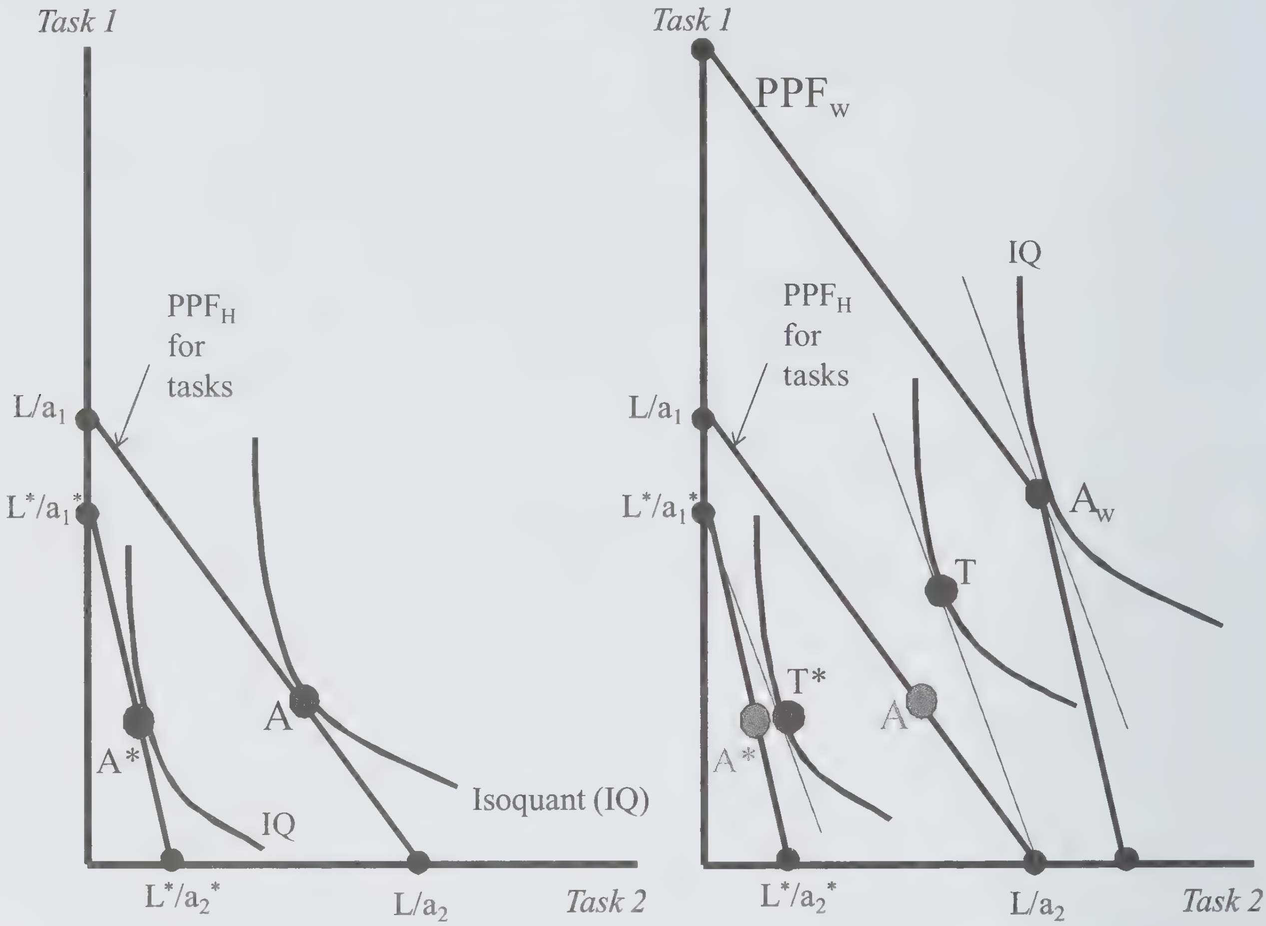
[2] Jones and Kierzkowski (1990) point out that it can be gleaned from Adam Smith's work; they also quote the 1928 American Economic Association presidential address by Allyn Young: "… over a large part of the field of industry an increasingly intricate nexus of specialized undertakings has inserted itself between the producer of raw materials and the consumer of the final product" (p. 34) The insight is quite explicit in Jones and Kierzkowski (2000) and implicit in the diagrammatic analysis in Jones and Kierzkowski (1998).

Figure 7: Trade in tasks as technological progress



At the world level, the optimal combination of task 1 and 2 is shown by the point A_w and the relative prices of tasks 1 and 2 are now established on the world market by the slope of the isoquant at A_w. The world relative price lies between the two no-trade prices (as it must if all labour is to be employed). This change in prices makes Home task 1 production uncompetitive, so all Home task 1 production is offshored and all Home labour shifts to task 2 production. The change in relative prices makes Foreign task 2 production uncompetitive, so all foreign task 2 production is offshored.

The right panel shows how trade in tasks shifts the final-good production point from points A and A* to T and T* (production of the final good is like consumption in the classic 2-good Ricardian model). Note that the isoquant tangents to T and T* are higher than the isoquants tangent to A and A*.

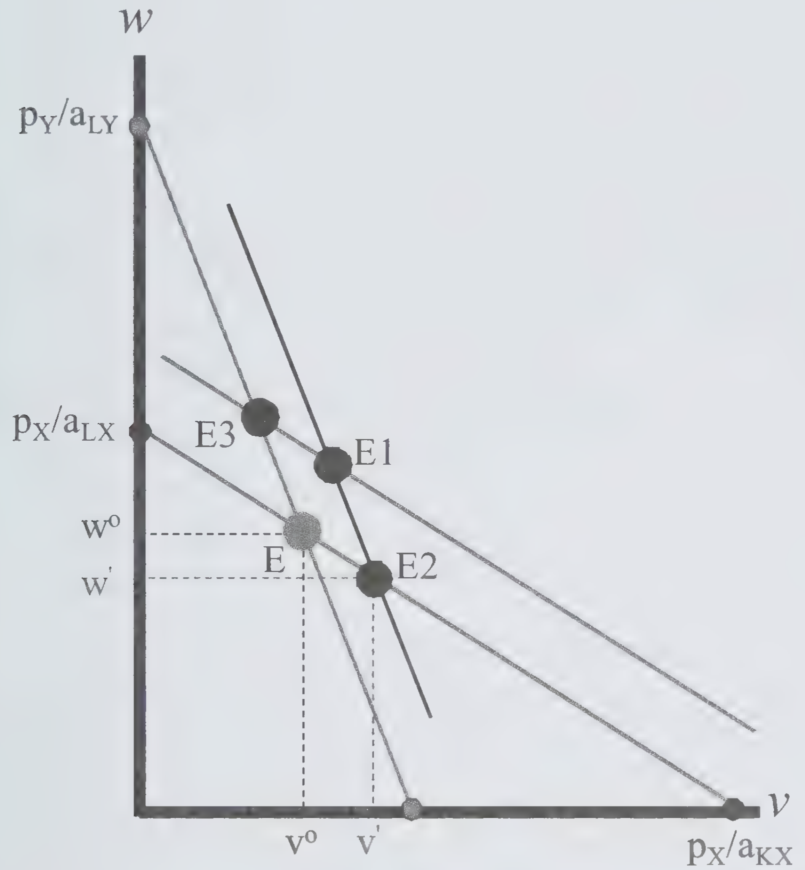
The result is just like technological progress in both nations. Trade in tasks allows Home and Foreign to produce more of the final good with the same amount of primary factors. Both nations' labour forces become more productive when the productivity is measured as final-good output per hour.

3.3.4 Wage effects of offshoring

Once we realize that offshoring is like technological progress, we can explore the general equilibrium wage effects of offshoring using a diagram like Figure 4. The result is shown in Figure 8. Since offshoring can occur in sectors and in tasks that are both skilled and unskilled labour-intensive, the new price lines will, in general, be shifted out. The new

intersection, however, implies that offshoring can raise skilled wages while lowering unskilled wages (as at point E2), raise both (point E1), or raise unskilled wages while lowering skilled wages (point E3).

Figure 8: Ambiguous wage effects of offshoring



This is one of the fundamental differences between the new and the old paradigms. As offshoring can affect both sectors, it is not clear which groups will gain or lose from further globalization.[3] More precisely, each sector is initially a bundle of tasks and the sector's factor intensity is the average intensity of all its constituent tasks. As unbundling proceeds, tasks are reallocated internationally roughly in line with comparative advantage. However, the process proceeds in both sectors, so the relative change in factor productivity – and thus the wage effects – is not clear cut.

3.4 What's really new? Globalization with higher resolution

As far as policy making is concerned, there are three really new things going on with globalization.

1. Unpredictability

[3] The papers that rekindled academic interest in North America over offshoring, or "trade in tasks," by Grossman and Rossi-Hansberg (2006 a,b), argued that offshoring unskilled intensive tasks would ambiguously raise the wage of unskilled workers, but this turned out to be a special case that arose from the authors' many special assumptions (Baldwin and Robert-Nicoud 2007).

The winners and losers from globalization are much harder to predict. By their very nature, lower trade costs for goods tend to affect all traded goods in roughly similar ways and this is why one could tell which sectors would win from further reductions in trade costs. Governments felt they could predict which sectors would win and lose from future globalization. This changes when the main barrier is the cost of co-ordinating complex processes across distance (trading ideas). Now it is difficult to identify winning and losing tasks, so we do not really understand the "glue" that binds such tasks together in the first place. Knowing the direct cost of telecommunications is not enough since it interacts in complex and poorly understood ways with the nature of the task and the task's interconnectedness with other tasks.

2. Suddenness

A job that three years ago was considered absolutely safe – say a German computer programmer designing custom software for a Landesbank – may today be offshored to India, or outsourced to a German software firm that offshores the job to India. The deep reason for this suddenness lies in the nature of complex interactions within factories and offices. Telecommunication costs have fallen rapidly but the impact has been quite different for different tasks. This may be due to the organization of tasks within offices and factories. This organization has changed more slowly. At some point – what might be called the tipping point – cheap communication costs line up with new management technology and a new task can be offshored to a lower cost location.

3. Individuals, not firms, sectors, or skill groups

In the first unbundling, one could view firms as "black-box" bundles of tasks since firm-against-firm competition was globalization's finest level of resolution. The Princeton paradigm suggests that the forces of globalization will achieve a far finer resolution at the level of tasks. This means that under globalization, particular workers in particular firms in a given sector could suffer while others in the same firm with the same educational attainment could prosper. New paradigm competition is on a much more individual basis and this has some implications for policy. Policies designed to help sectors may miss globalization's losers entirely.

In addition to these new features that are important from a policy perspective, it would seem that there are two additional features that change the classic economic analysis of globalization. These are:

4. Big versus little firm effects

At present, offshoring of services has been much more aggressively pursued by large firms, probably due to economies of scale or scope involved in offshoring. To the extent that it lowers the costs of big firms, offshoring alters the balance of big-versus-small firm competition in domestic and export markets. This has many implications. For example, suppose one was trying to work out how many jobs had been lost to offshoring. Given the shift on big–small firm competition, it is not enough to simply count the number of, say, data entry jobs offshored by large companies. The competitive edge gained by large companies will force small firms in the same nation and same industry to downsize or go out of business. This suggests the estimates would be too low. On the other hand, the large firm's gain in competitiveness would typically boost its sales and this would favour job creation in other tasks. Offshoring data entry jobs may lead a large truck manufacturer to hire more production workers. This suggests the direct estimates of job loss from

offshoring are overestimated. One would need a new-paradigm model to account for such intrasectoral effects properly. Of course, one could simply assume that offshoring lowered the marginal cost of big firms in a standard heterogeneous firms model, but this would start the story halfway through. It would not provide an analysis of the connection between the fundamental change (easier trade in tasks) and its effects.

5. "Us versus them" effects

Another set of issues concerns international intrasectoral competition. For example, suppose the home nation forbids outsourcing of data entry jobs in an attempt to save jobs. If other nations allow their firms to offshore, the home nation firms will find themselves at a competitive disadvantage. The expected result of this would be a reduction in home firms' production, so in the end the policy could end up indirectly destroying even more data entry jobs than offshoring would destroy directly.

Moreover, as parts and components are quite model-specific, and because transportation is relatively difficult and expensive, the unbundling of tasks at the factory level has not taken place over vast distances. Widespread adoption of lean production techniques and increasing product variety tends to foster spatial clustering of parts production and final assembly.

4. Relevance of the New Paradigm to North American Economic Integration

The trade-in-tasks theory was developed by Grossman and Rossi-Hansberg (2006b) primarily to examine the offshoring driven by low wages, which was the "issue du jour" in the United States at the time. The focus on large wage differences is misplaced in the US-Canada context, although it is still relevant in the broader North American Free Trade Agreement (NAFTA) context. The United States and Canada are both rich nations with sophisticated industrial firms in a range of sectors. Although wages are not equalized – and generally speaking Canada's productivity-adjusted wages are lower – wages are not massively different. A far more important problem with Grossman and Rossi-Hansberg's "new paradigm" is that fact that it ignores market size issues. A dominant element affecting the location of industry in North America is the huge market size advantage possessed by the United States. Since this factor is completely assumed away in existing trade-in-tasks theory, the theory must be extended to allow us to study the interactions among trade costs, agglomeration economies, and economic integration.

4.1 The trade-in-tasks framework when market size matters

The mainstream framework for studying the impact of market size on industrial location is the so-called new economic geography (NEG) literature launched by Paul Krugman in the 1990s (e.g., Krugman 1991). We briefly review the logic of this framework before discussing how to integrate it with the trade-in-tasks framework.

4.1.1 A new economic geography primer

The focus of NEG is on firms' location decisions. These decisions rest on the balance of two sets of forces: dispersion forces and agglomeration forces.

Dispersion forces, as their name suggests, favour the geographic dispersion of economic activity. These forces are generally driven by some sort of congestion broadly

defined. Most of these congestion factors (land rent, commuting time, etc.) are rather local and thus not directly of concern in this paper. Three dispersion forces are important.

First, is labour market congestion. Industrialization tends to push up wages and this tends to discourage further agglomeration. This is an important issue in the United States, Germany, Japan, and increasingly China.

Second is local market competition. This reflects the fact that having many industrial firms located in a particular region tends to increase the degree of competition for customers in the local market; this tends to encourage firms to spread out. Importantly, local market competition depends upon trade barriers. For example, in the extreme case where a nation's markets were perfectly open to international competition, we would see global, not local, competition, but short of this, trade barriers of all kinds tend to make local competition a more important consideration. This fact creates a direct link between industry location and all manner of trade barriers, ranging from tariffs to standards to border security checks. This linkage will play a key role in the policy discussion in Section 5. Agglomeration forces counteract dispersion forces.

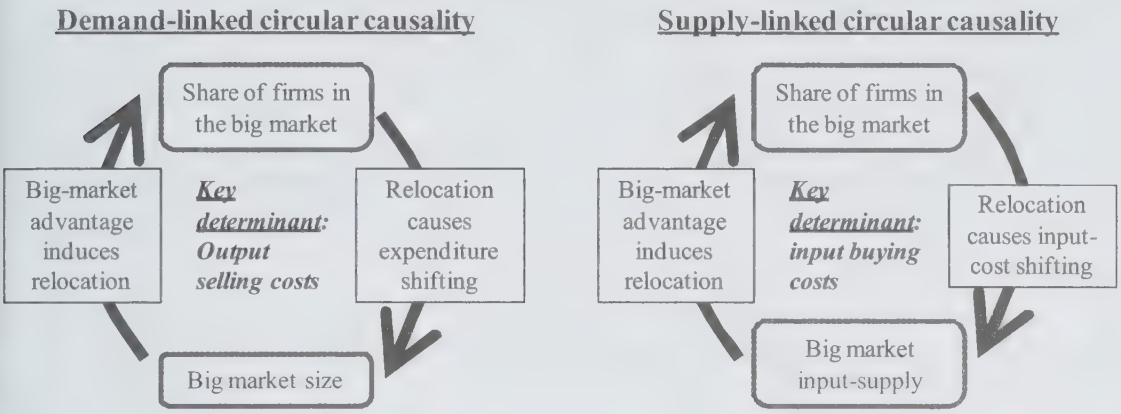
Third is standard comparative advantage. Nations are not all equally good at producing all things, or to phrase it in standard old-paradigm terms, nations have different comparative advantages. The sources of these differences can range from resource endowments to technological differences to natural geography. These constitute dispersion forces, since other things being equal, they imply that some types of economic activity should be done in all nations. At a sector level, however, the sources of comparative advantage tend to encourage clustering by sector. In the traditional trade framework, countries become more specialized as trade costs fall. For example, as trade barriers come down, an ever larger share of clothing production shifts to China. From the global perspective, however, this might look like the clustering of apparel production, but it is not driven by agglomeration economics.

An agglomeration force is said to exist when the spatial concentration of economic activity creates forces that encourage further spatial concentration. There are many agglomeration forces, but some of them operate on only a very local scale (like the knowledge spillovers that explain why university departments and government departments are typically clustered in a given building). This level of spatial clustering, however, is not relevant to this paper. The two agglomeration forces we consider are supply-side and demand-side circular causality; they operate at a continent-wide scale and are directly affected by trade costs (and thus affected by policy choices including tariffs and border infrastructure).

Demand-linked circular causality rests on market size issues. Firms want to locate where they have good access to a large number of customers, like the United States, in order to reduce selling costs (where selling costs include everything from shipping charges, border delays, and import duties to back-and-forth communication with customers). Firms buy inputs from other firms, so firm relocation affects market size and thus the causality becomes circular. If no dispersion forces are in operation to counteract this agglomeration force, all economic activity ends up in the big market. If all factors of product are mobile across borders, this force would tend to completely empty out small regions via factor migration; however, in the international setting we usually ignore massive cross-border movements of labour. (This demand-linked circular causality is a key factor in the rapid rural–urban migration observed globally. As internal transport costs fall, firms create jobs near big cities since they want to be near their customers; people move to the cities since

that is where the good jobs are, and the cycle begins again.) This is illustrated in the left panel of Figure 9.

Figure 9: Circular causality and agglomeration forces



The second major type of agglomeration force is the input cost-linked circular causality, or "supply linkages." This is the agglomeration force most relevant to production unbundling in the North American setting since it deals directly with supply chains. Manufacturing firms in modern industrial economies buy many inputs from other firms, such as machinery, parts and components, and specialized services such as marketing, accounting, and IT. Since it is cheaper to find and buy such input from firms that are nearby, the presence of many firms in a location tends to reduce manufacturing cost of doing business in that location, other things being equal.

Again, this leads to circular causality (see the right panel of Figure 9). If many firms are already in the big market, then doing business in the big market – all else being equal – will be cheaper and this will attract firms that in turn make the site more attractive from the input cost perspective. If there were no dispersion forces, this circular causality would empty out the small market entirely. (Inside nations, this goes a long way to explaining the spatial clustering of sectors; e.g. the chemicals sector and the automobile sector.)

4.2 The locational effects of liberalization

The focus here is on trade and industrial policy and one of the most direct effects of such policies is on trade costs. We therefore turn to studying the connections between trade costs and the location of industry in the NEG framework.

The first thing to observe is that lower trade costs reduce the strength of demand- and supply-linked agglomeration forces. As selling costs – including freight, border costs, and two-way communication with customers – fall, the incentive to locate in the big region diminishes. Likewise, supply-linked agglomeration is motivated by a desire to reduce the cost of buying intermediate inputs. As distance-related buying costs fall, the importance of being geographically close to suppliers shrinks.

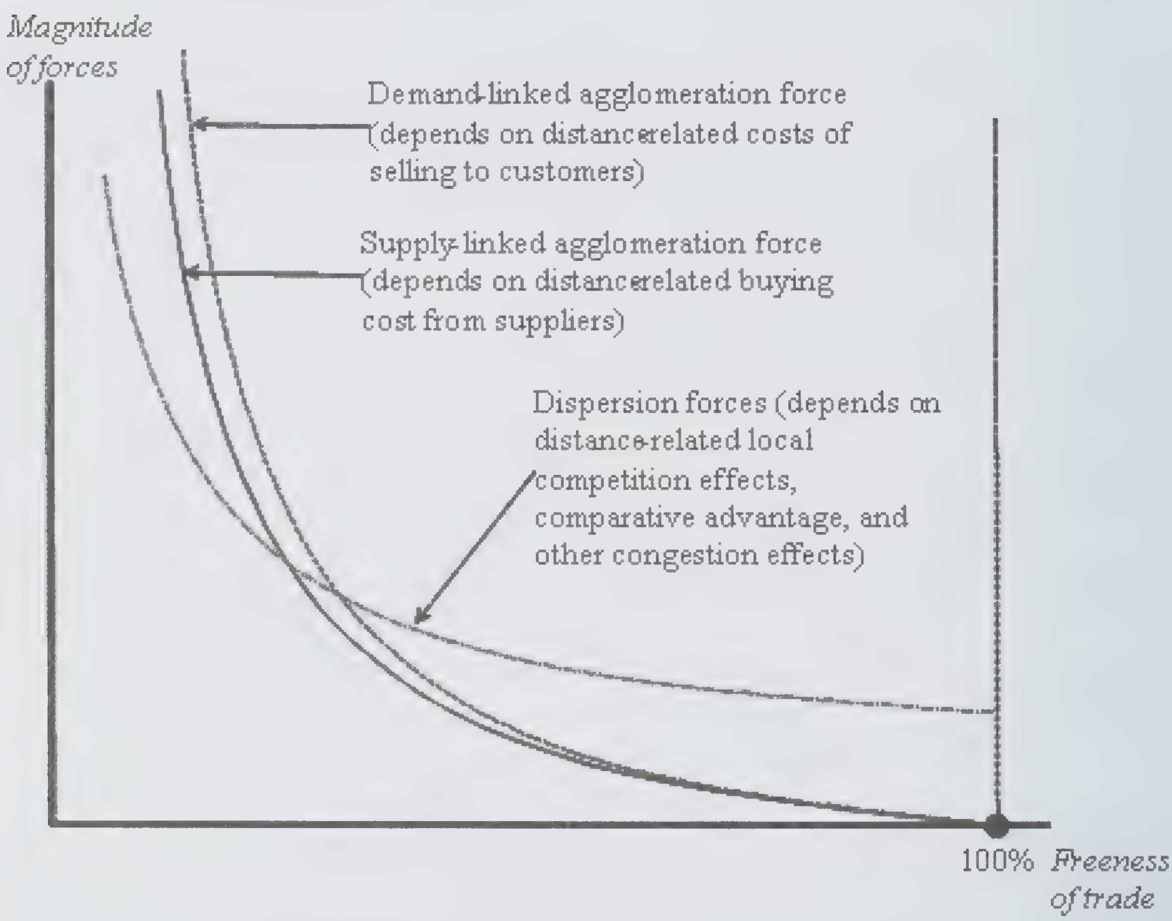
The distance-related dispersion forces also get weaker as trade costs fall. The key distance-related dispersion force is the local competition effect. Here again, reduced trade costs reduce the advantage of being located far from your competitors. Indeed if trade were to become costless, the local competition effect would disappear as the degree of competition would be the same regardless of where firms were located.

Importantly, many dispersion forces do not diminish with distance. For example, the labour market congestion effect – the tendency of industrial wages to rise in nations with

relatively high industry GDP shares – is not directly related to distance or trade costs. Other dispersion forces actually get stronger as trade gets freer. Comparative advantage is one: the trend for labour-intensive industry to move to labour-abundant nations, for example, gets stronger as trade costs come down.

To illustrate these relationships, Figure 10 plots the forces against the freeness of trade. It shows that both agglomeration and dispersion forces erode with trade freeness but that at totally free trade – i.e., costless trade – the dispersion forces would prevail. Quite simply, a world with costless trade would resemble classic trade theory where each nation's resources were fully employed and "each nation makes what it does best and trades for the rest." If this happened, industry would be far more evenly spread across the globe than it is now, where a handful of nations produce most of the world's manufactured goods.

Figure 10: Trade costs and strength of agglomeration and dispersion forces

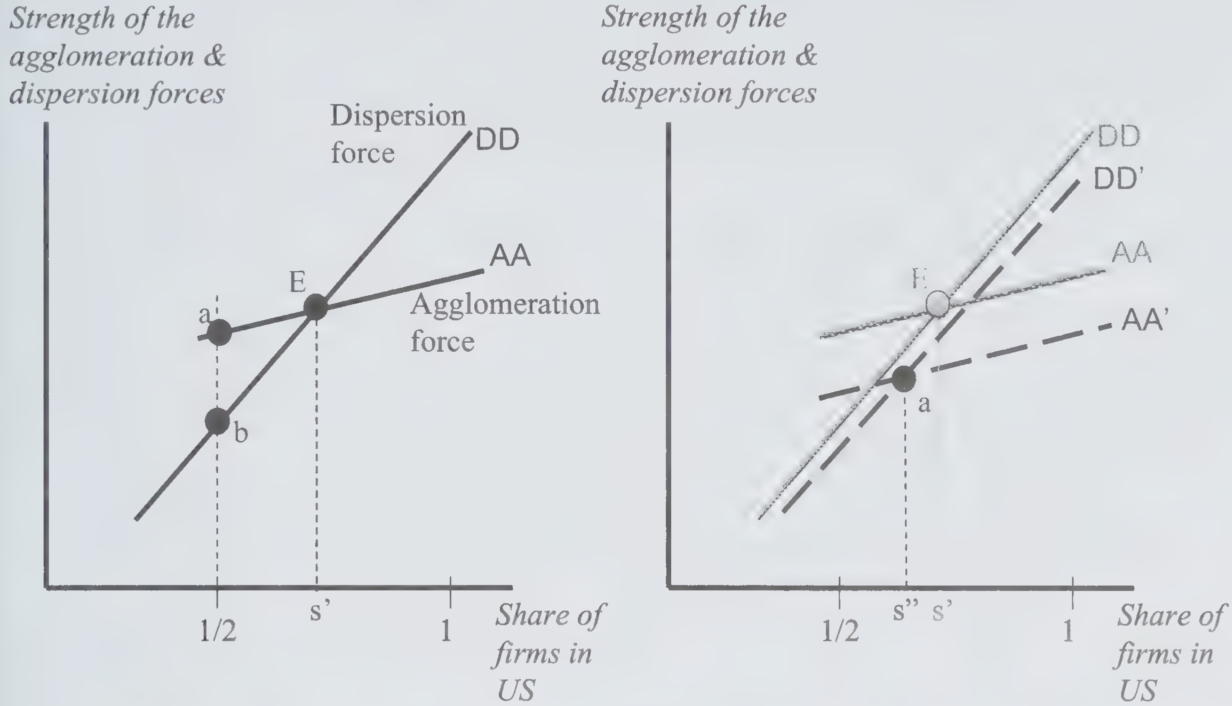


4.2.1 Determining the spatial equilibrium

Discussion of these forces and the impact of free trade prepares the ground for the main goal of this section: the study of the spatial equilibrium. As we shall see, the share of industry in the big region adjusts to balance agglomeration and dispersion forces much like a price adjusts to balance supply and demand.

To see this, it helps to have a diagram to crystallize our thinking (Figure 11). Both panels of the diagram plot the strength of agglomeration and dispersion forces on the vertical axis. However, in contrast to Figure 10 the horizontal axis plots the share of industry in the big region (the United States).

Figure 11: The locational equilibrium diagram



The left panel shows two lines, AA and DD, which illustrate how agglomeration and dispersion forces change with the concentration of industry in the United States. The agglomeration force line, AA, is rising due to circular causality (spatial concentration raises the incentive to spatially concentrate). The dispersion force line, DD, is rising since the benefit of staying in the small region rises as more firms move to the big market due to wage congestion and local competition effects.

The locational equilibrium is at point E. This identifies the share of firms in the big market (the United States) where incentives to agglomerate are just balanced by incentives to disperse. Given the United States's intrinsic size advantage, it is clear that a share of half is not an equilibrium (i.e., the strength of the agglomeration force at s= ½ is "a"; the strength of the dispersion force at s = ½ is "b"; if the share started at ½, agglomeration forces would drive relocation until the big region's share of industry rose to s').

4.2.2 Is free trade pro- or anti-agglomeration?

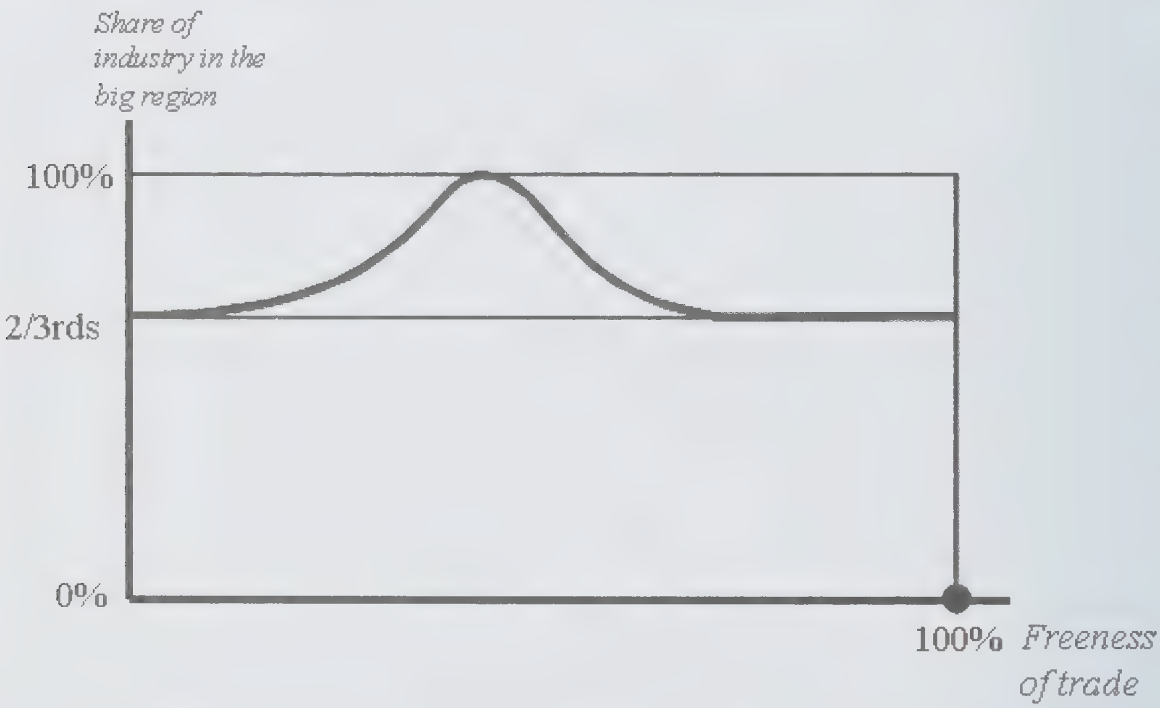
The left panel in Figure 11 was drawn for a given level of trade freeness. A critical issue for this paper is the impact that reducing trade costs have on the location of industry. This is studied in the right panel. As discussed above, lower trade costs generally make distance less of an issue and thus weaken both agglomeration and dispersion forces. The impact on the share of industry in the small region can go either way. If the agglomeration forces weaken more than the dispersion forces, the small region's equilibrium share rises (i.e., the US share falls). This is the case illustrated in the right panel, but plainly it could go the other way if DD fell more than AA.

As a rough rule, broad trade liberalization in recent decades seems to have fostered a dispersal of industry, which is why the left panel depicts liberalization as anti-agglomeration. We can see this at the global level (Organisation for Economic Co-operation and Development nations are de-industrializing while the emerging economies are industrializing; see Debande 2006), within Europe (see the auto industry example above), and between the United States and Canada. However, during the first wave of

globalization (roughly 1870 to 1914), lower trade costs were associated with a very strong agglomeration of industry in the North (especially in United Kingdom, the United States, and some West European nations) and a de-industrialization of the South (especially India and China; see Baldwin and Martin 1999).

The NEG literature explains both outcomes with the so-called hump-shaped nature agglomeration rents, which notes that the balance of agglomeration and dispersion forces is most strongly tilted toward agglomeration at *intermediate* trade costs. Consider the polar examples. When trade is highly restricted, it is very unprofitable for firms in the core (big) region to sell to peripheral markets. This dampens their enthusiasm for location in the core. Indeed, each region has to make everything it consumes, so the dispersion of industry matches the dispersion of consumers. At the other extreme of perfectly costless trade, location in the core or any other region is immaterial, so the gains from being in the core are nil. It is in between these two extremes – in other words, at intermediate trade costs – that location in the core matters most. For intermediate trade costs, clustering is both possible (since firms in the core can still sell to customers in the periphery) and profitable (since locating in the core economizes on trade costs).

Figure 12: The hump-shape relationship between agglomeration and trade costs



This widely known feature of the NEG logic leads to the seemingly contradictory conclusion that lowering trade costs when they are high tends to produce a concentration of firms in the big region. However, beyond some level of trade costs, further trade facilitation leads to dispersion away from the core.

This is shown in Figure 12. For the case of a big country that is naturally big, say it has two thirds of the world population and the small country has one third, a neutral or non-agglomerated location equilibrium would involve a two-thirds/one-third distribution of industry. When the freeness of trade is zero (autarky) and 100 percent (costless trade), the neutral distribution prevails. In between, agglomeration forces tend to encourage spatial concentration in the big region. Note, however, that once trade gets free enough, the dispersion forces that are unrelated or positively related to trade costs take over and push the equilibrium to the non-agglomerated state. While there is no clear empirical

dividing line, many economists believe that the advanced industrialized economies are beyond the turning point. Further globalization seems to be associated with a dispersal of manufacturing away from the big markets and toward nations with lower labour costs, especially those that are located in a way that naturally provides them excellent access to big markets. Baldwin and Krugman (2004) have used this feature to explain the changing nature of tax competition since the 1980s.

4.3 Threshold effects, trade cost/policy interactions, and hysteresis

Cluster economics presents policy makers with a set of issues that do not arise in more standard, smoother, more neoclassical models. Three of these are worth discussing in the present context (see Baldwin et al. 2003, Chapter 9 for a more extensive discussion, and Chapters 12 – 18 for applications to trade policy, tax policy, and subsidies policies).

When starting from a situation where industry is concentrated spatially, agglomeration forces can render small policy interventions useless, even though a large policy intervention could be effective. Firms located in a region with a large concentration of industry enjoy agglomeration economies, as explained above. (In many cases, governments and labour unions in the core region attempt to "tax" these agglomeration economies by charging higher taxes and demanding higher wages, higher benefits, stricter firing conditions, etc.).

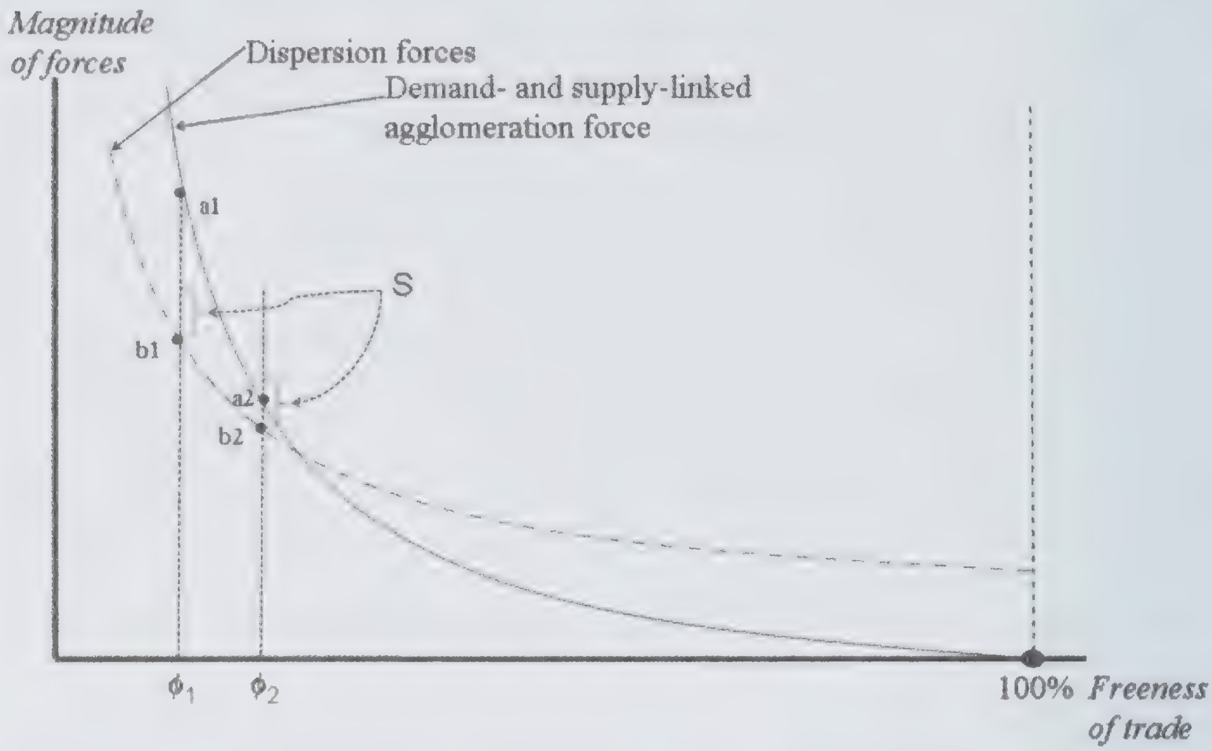
Threshold effects arise since it takes a sufficiently large policy push, say a production subsidy or tax holiday, to attract firms away from the agglomeration rents available in the core. Unlike the standard neoclassical framework, one does not observe a little relocation from a little subsidy. One observes no relocation until the subsidy passes a particular threshold and then the effect can be larger than expected. The reason is that as firms start to locate away from the core, circular causality runs in reverse. Relocation of some firms reduces the attractiveness of the core and boosts that of the small region.

Importantly, the level of trade costs can interact in unexpected ways with the relocation policies. Figure 13 shows an example. Consider a level of trade freeness equal to ϕ_1, where the agglomeration forces (whose level is shown by a1) are stronger than the dispersion forces (shown by b1). At this point, a subsidy to firms that relocate to the small region will not be effective unless it is at least equal to the difference between a1 and b1. Suppose that a subsidy equal to S is offered nonetheless, but no firms relocate to take advantage of it since the subsidy doesn't offset the relative attractiveness of the big market. Things change when trade gets free.

If trade gets freer, thus narrowing the advantages of being in the big region, the same subsidy may well have an effect. In the example, a rise in trade freeness to ϕ_2 would narrow the gap between agglomeration and dispersion forces to a2 minus b2. Since the subsidy S exceeds this gap, some firms would relocate in response. This means that trade facilitation programs will tend to amplify the impactfulness of Canada's pro-industry policies ranging from R&D policies to health care.

Hysteresis is the next concern. The world of real economic geography is marked by "path dependencies." The reason is that there are many possible places for industry to agglomerate, but once an agglomeration gets started – or for that matter starts to unwind – it can be very difficult to reverse the trend.

Figure 13: Trade cost and relocation policy interactions



For example, a temporary policy that punishes firms in a particular location may lead them to depart, or may deter them from coming to the location in the first place; if trade is quite free, the policy can even be a rather small one. To be concrete, suppose the policy change is a rise in the corporate tax in a particular region that induces firms to choose another region. When the policy mistake is reversed, and taxes are restored to their initial point, no relocation occurs. The reason is that the firms are now enjoying agglomeration economies in some other region, and simply restoring the initial policy situation will not be sufficient. This property of irreversibility is called "hysteresis" in physics. Krugman (1991), who presents several historical cases where random events lie behind the establishment of large industrial agglomerations today, calls this the "history matters" property. Baldwin (1988) looks at the case of hysteresis due to large exchange rate fluctuations.

With these preliminaries out of the way, we turn to the main task of this section: extension of the trade-in-tasks framework to allow for agglomeration effects.

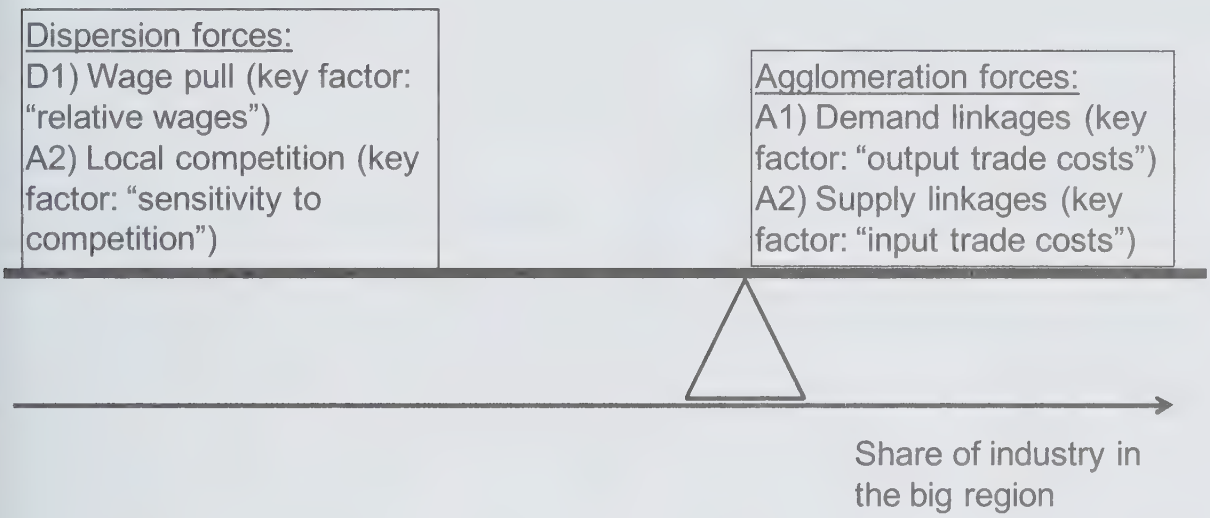
4.4 Adding trade in tasks: Unbundling when supply and demand linkages are important

How does production unbundling fit into the NEG? The standard NEG approach views firms as a production bundle; the range of production stages performed inside the firm is taken as immutable. Production unbundling changes this. To be specific, consider a car whose components' production must initially be spatially bundled with final assembly (due to communication costs, delays, and uncertainty). When ICT advances make production unbundling possible, the components can be produced by separate factories on either side of the border. Almost surely, this will alter the spatial distribution of industry because the balance of agglomeration and dispersion forces will be different for each component.

In fact there is likely to be a very clear pattern in the relocation produced by unbundling. To see this, it is useful to conceptualize the location equilibrium (i.e., the

share of industry in the big market) as balancing the weight of agglomeration forces on the one hand and dispersion forces on the other (Figure 14). In this approach, the spatial division of industry is the fulcrum that balances agglomeration forces (on the right end of the lever) against the dispersion forces (on the left side of the lever). The location of the fulcrum when the lever is in balance describes the share of industry in the core region. Anything that strengthens the agglomeration force (i.e., increases the weight of the agglomerate forces in our lever analogy) requires the fulcrum to shift rightward to rebalance the forces (implying an increase in the share of industry in the big region). Factors that strengthen dispersion forces will shift the fulcrum to the left (more dispersion). Of course, what really matters is the relative weight on the two arms.

Figure 14: Location equilibrium: Fulcrum, load and effort arms, and the weight of forces



Using the lever analogy, it is easy to see that unbundling will almost surely alter the location of industry. The text in Figure 14 (which summarizes the discussion in the previous section) indicates that we can focus on five key factors determining the spatial division of industry: (1) relative wages, (2) sensitivity to local competition, (3) output-selling trade costs, (4) input-buying trade costs, and (5) cost share of intermediate goods.

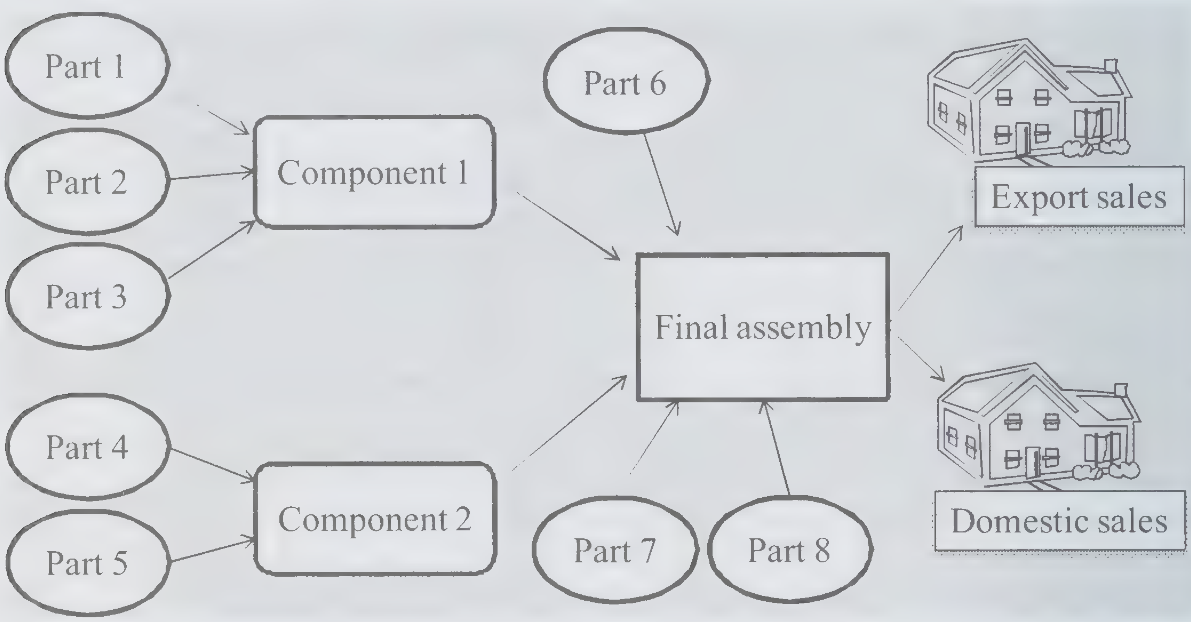
The initial equilibrium balanced forces for the production bundle as a whole; i.e., it is the bundle's average agglomeration and dispersion forces that mattered, where the average is across all manufacturing stages. Because the components will individually face a different balance of dispersion and agglomeration forces, the production location of some components will change. But in which direction?

While details will dominate in particular cases, the logic of trade in tasks suggests that unbundling tends to reduce concentration in the big market, but especially in upstream production stages. The key is that supply-linked agglomeration forces are systematically less important for production stages near the beginning of the value-added chain since these stages buy fewer traded inputs.

To see this, consider the stylized supply chain in Figure 15; parts are assembled into components that are in turn combined with more parts to produce the final good. It is immediately apparent that parts, components, and final assembly face different types of agglomeration forces. For all of them, demand-linked agglomeration forces matter since all of them must sell their output and thus output-selling trade costs matter. Parts, however, do not themselves buy intermediate inputs; they are, in the example, produced directly

from primary factors such as capital and labour. As a consequence, the production of parts is not subject to supply-linked agglomeration forces; i.e., input-buying trade costs are irrelevant. As far as dispersion forces are concerned, the key is that the advantages of lower labour costs in the small region apply equally pre- and post-unbundling. Now putting these observations together with the fact that the average agglomeration force matched the average dispersion force in the pre-unbundling equilibrium, the bundled spatial equilibrium will no longer be correct for parts. The dispersion forces for parts alone will outweigh the agglomeration forces and some of the parts making will be offshored.

Figure 15: A stylized supply chain

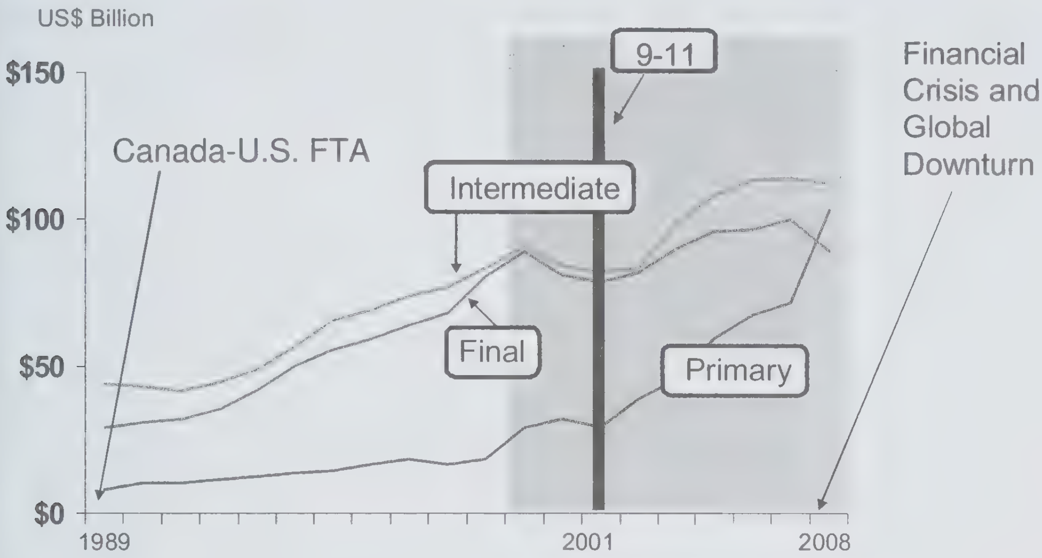


In Figure 14 terms, the agglomeration forces are "lighter" for parts than they were for the whole bundle, so rebalancing requires the fulcrum for the parts industry to shift leftward (i.e., the share of parts production in the big market will fall). Parts, in other words, will be outsourced and offshored to the small region because supply linkages are weaker for the initial production stages that use fewer intermediate goods. The recent data on the export of goods to the United States from Canada presented in Figure 16 provides some support for this within the North American context. Since 2003, there has been a notably faster rise in intermediate good exports to the United States, than final good exports.

This may not be the end of the story. The relocation of the parts industry may have a knock-on effect due to supply linkages. The shifting location of parts makers to the small region will make the small region more attractive to components manufacturers, in particular those that have a very high intermediate goods cost share and those for whom input-buying trade costs are high (e.g., for the parts that are particularly expensive to transport due to fragility or weight) and whose output-selling trade costs are low (e.g., for components that are easy and cheap to ship).

In short, the greater dispersion of parts makers dampens the attractiveness of the big region to component makers. This reduction in the "weight" of agglomeration forces for components triggers a leftward shift in the fulcrum for the components industry. This in turn will feed back to weaken the demand-linked agglomeration force in the parts industry, as the component firms are the customers for parts firms.

Figure 16: US Imports from Canada



Source: USITC DataWeb, based on HS 6-digit (5000+ categories)

The basic point of the knock-on effects can be rephrased as follows. As the parts must somehow get to the component maker's facility, and the components must somehow get to the final assembly plant, the question is whether it is more efficient to ship parts across the border to component makers, or to move the component makers' facilities to the same side of the border as the parts makers.

The same logic does not apply to final assembly since it is tied to the large region's massive consumer base. The shifting of parts and components to the small region reduces the supply-linked agglomeration forces in final assembly. However, unlike the parts and components segment of the industry, final assembly continues to face unaltered demand-linked agglomeration forces arising from the location of so many final consumers in the big market. Thus there is likely to be a less than proportional shift in final assembly to the small region.

Additional factors come into play in determining the location of production after unbundling.

- The labour intensity of the various unbundled parts and components will differ (in the initial bundled situation what mattered was the average labour intensity). Since a typical situation in the real world (and in the NEG theoretical models) is that equilibrium labour costs are higher in the big nation, relocation to the small nation is more likely, all else being equal, for labour-intensive stages of production.
- Relocation will entail higher transport costs (shipping to the big market), so relocation will tend to be more attractive for parts and components that are easily, cheaply, and reliably shipped.
- Unbundling may also change scale. Bundling may have prevented some of the components from achieving their most efficient scale of production. An example of this is "shared platforms" in the auto industry. For such components, unbundling, by allowing a single component factory to serve more than one final good producer, will raise the scale of production and result in a spatial grouping of production. The location of these large factories will involve the same balance of forces as in Figure 14.

5. Policy Issues

Having explained the basic conceptual framework – in particular the extension of the trade-in-tasks approach to allow for agglomeration economics (NEG) – we turn to a number of policy implications, starting with trade facilitation.

5.1 Impact of trade facilitation

The basic logic of agglomeration suggests that the US economy's size is an enormous advantage in attracting and keeping industry. But the large-market benefits of producing in the United States are set against the negatives stemming from local competition and higher wage costs. Presuming that most industries are on the downhill side of Figure 12, anything that makes US-Canada trade cheaper, faster, and more predictable will tend to erode the attractiveness of the United States's market size. This, in turn, would tend to promote Canada as a location for industry.

Notice that trade costs entered the equation in two ways: the cost of buying necessary intermediate goods from across the border, and the cost of selling output across the border. As the United States starts with a larger concentration of both customers and input producers, a reduction in either or both costs will reduce the United States's market size advantage and thus foster the location of industry in Canada. This is just a general prediction of Krugman's new economic geography approach: free trade reduces the large market's advantage. The point, however, can be augmented with considerations arising from production unbundling.

The first point to make is that production unbundling has the effect of putting into play a large number of industrial jobs that were previously bundled into larger plants – plants that were in turn attracted to the United States's large consumer market. More precisely, the NEG-cum-trade-in-tasks logic teaches us to think of unbundling as a large drop in the distance-related, input-buying trade costs. Before unbundling, it would have been prohibitively expensive to try to manage the sort of international supply chain we see today. Or to put it differently, firms located the production of parts and components close by – often in the same factory complex – in order to economize on input-buying trade costs broadly defined.

The second point returns to the interaction between pro-dispersion policies – like Canada's health care system, its production support, etc. – and trade costs. The example shown in Figure 13 is a rather general proposition. Indeed it is absolutely obvious once one sees that the advantages of being in the big market are eroded by lower trade costs. What this means is that the effectiveness of a particular pro-relocation policy will typically become magnified as trade costs fall. Trade facilitation, in short, can be a "force multiplier" for Canadian industrial policy.

The third point is that the unbundling allows dispersion forces to operate more finely on the value-added chain. Tasks, in other words, will tend to migrate to nations that have the most appropriate factor prices. This should help Canada to develop more finely defined strengths in manufacturing segments that correspond more precisely to natural comparative advantages.

5.2 Labour and industrial policy

One of the key dispersion forces fostering the location of industry in Canada is its low productivity-adjusted labour costs and favourable manufacturing incentives. (This paper does not address the social welfare consequences of such policies, but rather focuses

on their location effects.) As discussed above, these dispersion forces are magnified by lower trade costs. This suggests that the impact of attractive labour and policies could rise as trade within North America becomes cheaper and more reliable. The same is true of R&D policies that prove attractive to component producers. This, of course, is just the reverse of the point that trade facilitation is a force multiplier for industrial policy.

5.3 Most favoured nation tariff policy

The situation of Canada in North America is particular. It has a labour-cost advantage over the United States, but Mexico's wage cost advantage is far greater.

External trade policy can help meet this challenge. Lowering the cost of importing parts that are intensive in low-skilled labour is a direct response to the supply linkages created in Mexico by their abundance of such labour. As Robert Mundell (1957) noted decades ago, trade is a substitute for factor movements. The direct way to counter Mexico's advantage would be for Canada to "import" low-skilled labour. Mundell's insight, however, tells us that this is not necessary. Reducing tariffs and other border costs on low-skill-intensive parts will tend to offset the attractiveness of the Mexican market and US locations near the Mexican suppliers of these goods. After all, the key to these supply linkages is the price of the input. The input's production location is relevant only insofar as it affects the price. Providing Canadian component makers with competitively priced parts from third nations directly offsets the locational advantage created by the production of such parts in Mexico.

5.4 Unbundling and rules of origin

Any nation that applies preferential tariffs must have rules of origin (ROOs) to guide customs officials. These rules, however, have de facto been used to influence the location of industry. The traditional view is that strict ROOs foster the production of upstream intermediate goods. The trade-in-tasks framework, suitably extended to allow for cluster economics, can provide some new insights.

Unbundling has and will continue to alter the politics and economics of ROO. In a nutshell, ROOs are a way of bundling together the tariff protection enjoyed by upstream and downstream producers. Insofar as unbundling further fragments a sector, it tends to erode the coalitions backing tariff-protection bundling (i.e., strict ROO).

5.4.1 The basic economic effects of rules of origin

The basic impact of unbundling is to make the ROO coalitions more difficult to manage. As production stages are separated spatially, especially when their ownership is also separated, the intrinsic conflicts between parts makers and parts buyers become more problematic, especially when the outsourced parts are moved outside the nation. It may be the case that ROOs are saving industry jobs, but whose? As unbundling and spatial dispersion of upstream manufacturing proceeds, the nationalistic argument for ROOs tends to get blurred. Moreover, if unbundling results in a multiplication of firms, it will make political organization more difficult.

5.5 Product standards and unbundling

Citizens expect their governments to impose health, safety, and environmental standards on the goods they buy. As intermediate inputs are an essential element in many

final goods, it is also natural to impose standards on upstream products as well as consumer products. But product standards also play a protection role (Baldwin 2000). Unbundling suggests that pressures for this sort of protection will unwind from the beginning of the value-added chain and moving forward. There is a close analogy with the logic concerning ROOs and MFN tariffs.

As manufacturing becomes unbundled and geographically dispersed, especially when parts production is both outsourced (produced by a different company) and offshored (produced in a differ nation), firms that "won" from the protection provided by idiosyncratic standards may find themselves turned into losers. That is, as unbundling turns large companies into buyers of parts, there will be increasing pressure to lower costs by adopting international standards. This basic logic parallels that concerning the difficulties of maintaining coalitions in favour of strict ROO.

As far as policy is concerned, the usefulness of this insight is to avoid developing industry that will not be viable once international norms are adopted, especially in upstream stages of the value-added chain.

There is a second logic that suggests unbundling will favour the adoption of international standards. As discussed above, unbundling may allow certain segments of the production chain to achieve the minimum efficient scale that was not possible when they were tied to an individual downstream firm. That is, the unbundled firm can, by selling to more than one downstream firm, achieve greater economies of scale. But once firms start selling to more than one final good producer, they may face the problem of multiple standards. Since lowering these costs is likely to be in the interest of buyers and the sellers, this aspect of unbundling may foster the elimination of standards-based protection. To put it differently, overlapping standards becomes more of a problem when the supply chain gets unbundled and dispersed around the world. For policy makers, this suggests that efforts be made to advance the internationalization of industrial standards.

6. Concluding thoughts

The globalization of manufacturing will surely continue, and the globalization of services production is just starting. Two of the forces driving this globalization are the rising competitiveness of emerging economies' producers (China, India, etc.) and the advancing sophistication and falling cost of communication and information management systems.

On the rise of the emerging market manufactures, little needs to be added to the voluminous discussion; suffice it to say that a growth takeoff has begun in these nations. While they may find growth gets harder as they approach the productivity frontier, it looks certain that they will at least reach the output per person of nations like Korea or Taiwan. That would mean a fourfold increase in output, with a more than proportional rise in manufacturing output. Such a large increase in selling and buying power will greatly magnify the pull and push factors driving globalization. The world's economic landscape will surely continue to flatten as far as manufacturing is concerned.

On the advance of communications technology, there is no end of the ways things could improve. If today's most advanced teleconferencing technology (large screens, multiple cameras and microphones, etc.) became as cheap and widespread as online telephony is now, trade in services would be revolutionized; the need for face-to-face meetings would be greatly diminished. The unbundling of the service sector has only just begun, hindered as it is, by the fact that it is still very expensive to move people around the

world (falling airfares are offset by rising opportunity costs of time) and it is still necessary for many service producers to interact in person, at least periodically.

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Causes of International Production Fragmentation: Some Evidence

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Introduction

What forces have driven international fragmentation of production in recent decades? Perhaps technological innovations in information technology have allowed the coordination of integrated production processes that are separated by vast distances. Perhaps reductions in transportation costs, tariffs and other trade barriers facilitated multi-stage production, allowing components to cross several international borders and/or long distances with relatively low accumulated transit costs. Perhaps changes in the political economy of new market economies (first in Eastern Europe and then in East Asia) have opened up new possibilities for specialization in different segments of the supply chain. Each of these explanations undoubtedly plays a role, of course, and the interaction of these effects is also important. This document attempts to identify evidence that points towards one or more of these theories as a leading cause.

The definition of international product fragmentation used here follows Athukarola (2006): 'the cross-border dispersion of component production/assembly within vertically integrated production processes.'[1] The nature of the phenomena of interest might be illustrated by an example. A major manufacturing export of St Kitt's and Nevis, a small island nation in the Caribbean, is *electrical switches*. The major import commodities in St Kitt's and Nevis include *telephonic and telegraphic switching apparatus* and *electrical resistors*, both presumably inputs into the production of switches bound for export. One can imagine that the switches exported from St Kitt's and Nevis, upon reaching their destination, may well be incorporated into electrical components that are themselves exported for further processing. It is phenomena such as the specialization of St Kitt's and Nevis within an international vertical production chain that is the topic of interest to this paper.

The data available for an empirical assessment of these phenomena are imperfect, so we use different data series to evaluate different propositions. First, we use the OECD's consistent country-level input-output tables to investigate changes within national economies. These data allow an assessment of the characteristics of industries that have seen growth in the degree to which they participate in global markets. Of specific interest is the question of whether manufacturing industries that have been exposed to greater innovations in key service sector activities are those that have seen greater international sourcing of parts. Our regression framework allows us to evaluate whether there is evidence of systematic changes across industries and countries that links structural changes

[1] There are a number of related phenomena including outsourcing (i.e. changes in the boundary of the firm), foreign direct investment, and increasing trade in producer services with which we will not formally engage.

in industry purchases of key services to increased use of imported intermediate inputs such as components, parts and accessories ('parts').

The second exercise uses international trade data from across the world to evaluate changes in the share of parts trade across countries and over time. The international trade data give global coverage, and allow an investigation of specific hypotheses about the types of countries that have become more active in global parts trade.

The final exercise exploits U.S. import data. These data include details such as transportation mode choice, freight charges, and duties paid. This information is not available in the global trade data, and allows us to investigate specific hypotheses about the role of changing trade costs and shipment modes in parts trade. Importers' observed reliance on air vs. sea modes provide evidence on the role of speed in parts trade.

The picture that emerges puts significant weight on political economy reforms in countries that once had centrally planned economies. Such economies appear to export a disproportionate volume of parts, after controlling for per capita income and size. The integration of these countries into global parts trade seems to have occurred rather rapidly, with significant evidence of such integration by 1996. There is also evidence from U.S. data that parts trade has become relatively more dependent on air shipments than has trade in similar products. Evidence on the role of key amalgamating and coordinating services is lacking here, although the available data are not especially well suited to the task.

The paper is organized as follows. The following section explains several hypotheses that have been put forward as potential causes of the growth in product fragmentation. Section 3 uses country level input-output tables to look for cross-industry, cross-country changes in the nature of intermediate trade growth. Section 4 exploits global international trade data to identify the characteristics of countries that have seen a growing role in trade in international parts. Section 5 exploits the US trade data to investigate specific hypotheses about the role of trade costs and shipments modes. Section 6 concludes.

Explanations

As noted above, the purpose of this document is to evaluate hypotheses about the global fragmentation of production, which is defined as 'the cross-border dispersion of component production/assembly within vertically integrated production processes.' There are a number of explanations for growth in such activities. The purpose of this section is to explain them, offering suggestions, where possible, about how such explanations might be taken to the data. Initially, we outline two related frameworks within which specific hypotheses can be explored: production fragmentation, as it is presented in Jones and Kierzkowski (1990), and vertical specialization, as presented by Hummels et al. (2001). We then turn to specific hypotheses about potential explanations for recent changes in the two types of activity.

Frameworks

Intermediary services and production fragmentation

A useful overarching framework for this analysis is put forward by Jones and Kierzkowski (1990). These authors propose a (somewhat informal) model in which various 'production blocks' are linked by service sectors (especially in transport,

communications and information technology).[2] The key point is that the relevant service sectors are necessary for the coordination or amalgamation of production activities that take place in disparate locations. In this framework, fragmentation of production implies that the cost of coordinating multiple activities in their respective low-cost locations is lower than the cost of integrated production in a single location.

An intriguing feature of this framework is that the coordination/amalgamation activities are taken to have increasing returns to scale.[3] In this context, the presence of increasing returns to scale suggests large investments in these sectors can produce significant and enduring reductions in the marginal costs of coordination/ amalgamation. Costly investments in telecommunications and/or transportation networks are obvious sources of increasing returns that are relevant to this discussion. Both the laying of internet cables in telecommunications, and investments in facilities that allow containerization in transport are plausible large, up-front investments that have dramatically reduced the marginal costs of coordinating and amalgamating production activities over diverse locations. A belief that such investments are important naturally leads one to the Jones and Kierzkowski (1990) framework.

Underneath the umbrella of the Jones and Kierzkowski (1990) framework, there is substantial room for alternative explanations for growing international fragmentation. The headline story, of course, is that reduced costs of services that facilitate coordination or amalgamation of globally dispersed activities can lead to increasing fragmentation. Potential causes for reduced costs of these activities might be technical innovation, costly investments with increasing returns to scale, or both. In the presence of increasing returns to scale, a growing international economy is itself a reason for increased production fragmentation, as a larger market allows fuller exploitation of increasing-returns-to-scale investments in the service sectors that facilitate coordination and amalgamation of disparate manufacturing activities. A larger world economy might simply have arisen through the regular process of economic growth, but it might also have been sped up by the inclusion of formerly non-market economies such as China. The addition of these economies might also have expanded the set of choices over relative factor bundles amongst market economies, opening up further possibilities for specialization. The Jones and Kierzkowski (1990) framework can also accommodate stories about reduced trade frictions (i.e. tariffs), though such explanations are only tangentially related to the central line of argumentation.

Vertical specialization

A complementary framework that is useful for understanding international production fragmentation is the concept of vertical specialization put forward by Hummels et al. (2001).[4] This framework emphasizes the role of sequential production staging within international production networks. In Hummels et al. (2001) the specialized

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[2] A formal theory that is largely consistent with the Jones and Kierzkowski (1990) framework is Grossman and Rossi-Hansberg (2008). Theirs is a formal model of 'trade in tasks.'

[3] Increasing returns to scale are not strictly necessary for some of the hypotheses that will be considered. A permanent reduction in fuel costs, for example, might reduce transportation costs and increase fragmentation without requiring any significant increasing returns to scale. However increasing returns to scale are a plausibly important feature of services like transport and communications, and should be part of the discussion.

[4] Hummels et al. (2001) attribute the concept to Balassa (1967) and Findlay (1978).

tasks undertaken in various countries are thought to be vertically linked, so that one country takes some inputs, adds value, and then send those inputs onto another country for further processing.[5]

Hummels et al. (2001) demonstrate the growth of this phenomenon through an assessment of national input-output tables. Using input-output analysis, they show that the embodied imported content of exports grew almost 30 percent between 1970 and 1990, on average, across 14 countries. Such calculations are fully consistent with the idea that production fragmentation is occurring through specialization in particular stages of multi-stage production chains. Given the highly aggregated nature of international trade data in input-output tables (the industries themselves are highly aggregated, and the input-output tables lack information on the origins of imports and the destination of exports), the calculations are unable to place countries at particular stages of the production chains. The focus of Hummels et al. (2001) is measuring both the levels of, and the changes in, the implied values of imported content in exports.

In the context of the work in this document, vertical specialization does not offer new hypotheses about possible sources of growth in production fragmentation. Rather, vertical specialization acts as a magnifier of particular forces driving fragmentation. The key hypothesis put forward in the vertical specialization literature is that the effect of trade cost reductions on cross-border trade volumes is substantially magnified by the presence of vertical specialization. Since spreading multiple production stages across many countries means that the output of early production stages crosses multiple borders and considerable distances, high trade costs can seriously impinge on such activities.[6]

Hypotheses

The goal of this project is to identify hypotheses about the growth of production fragmentation, and, to the extent possible, evaluate these formally. In this section we describe the phenomena of interest, and describe shortly how such changes are evaluated later in the document.

Many of the proposed hypotheses might have facilitated growth in international trade, even in the absence of production fragmentation. So, for example, the entry of China and other low-wage manufacturers into the global economy are thought to have increased manufacturing trade. They might have done this without inducing production fragmentation.[7] Thus a key difficulty in this exercise is to separate the effects that might have produced a more general increase in international trade in manufacturing from the particular factors that had a specific impact on the production fragmentation.

Hypothesis one: A central idea in Jones and Kierzkowski (1990) is that a critical input in fragmented production processes are key intermediary services that facilitate the coordination and amalgamation of dispersed production activities. A number of candidate service industries might be named. The focus here is on three service sectors of interest:

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[5] These ideas are not inconsistent with the Jones and Kierzkowski (1990) framework, which can accommodate vertical specialization, though that framework does not formalize the sequential nature of production staging.

[6] See Yi (2003) for a formal statement of the claim, and a quantitative estimate of the role of vertical specialization in world trade growth.

[7] In a standard trade model with only final goods, the entry of such countries into the world economy would generate a shift of entire final goods industries, rather than intermediate stages within industries.

transportation, telecommunications, and information technology. Each of these sectors have seen important technical innovations in recent decades. They have also seen large investments that are consistent with the main idea in Jones and Kierzkowski (1990) that such sectors experience increasing returns to scale. The development of global standards for containers, along with the spread of container-ready ports, required substantial investments aimed at reducing marginal costs of shipping. Investments in broad-band technology have reduced costs of telecommunications, with flow on benefits for the information technology sectors. Information technology and improved telecommunications technology have, in turn, improved logistics. For example, the use of global positioning systems, along with efficient telecommunications and information technology, allows firms to better track and schedule their shipments of goods.

These ideas are difficult to evaluate formally in a simple empirical test. Put at its simplest, it seems that the Jones and Kierzkowski (1990) framework suggests that intermediary service sectors are complements in production to the use of imported intermediate inputs. We will formally examine this idea using input-output tables from the OECD. Our test will look for commonalities across countries and manufacturing industries in the joint use of these service sectors and imported inputs. Because there is substantial variance across manufacturing industries and countries in the degree to which these sectors and imported intermediate inputs are employed, the focus of the hypothesis is on joint changes in the use of the nominated service sectors and imported inputs. If changes in these service sectors have driven product fragmentation, then country-sector pairs in manufacturing that increased their use of these sectors should have seen a relative increase in the share of intermediate inputs that are imported.

Hypothesis two: Just-in-time production processes rely on the reliable flow of parts from one stage of production to another. One mechanism for assuring prompt and reliable delivery of products is the use of high speed transportation, especially air shipments. Hummels (2007) notes that an important relative price change that has occurred in recent decades is the fall in the relative price of shipping via air freight. These price reductions might explain growth in global production chains. We shall explore the role of increasing reliance on air transport in product fragmentation using the OECD's input-output tables. We shall also look for evidence on this point in the U.S. import statistics, which report information on the mode of shipment.

Hypothesis three: The entry of new economies into the global marketplace in the late 1980s and early 1990s created new opportunities for international organization of production. China is one obvious entrant into global marketplace during this period. The entry of formerly communist countries in Eastern Europe has also been a pluasible reason for increased processing trade.[8][9] Using the Jones and Kierzkowski (1990) framework, the entrance of new economies into the market system generates the potential for new production blocks to emerge, allowing for greater potential for fragmentation. The key

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[8] One might have also taken trade and other market liberalization measures in countries like India to be important for offshoring. Indeed, this is quite plausibly important. In order to maintain a sharp hypothesis for empirical testing, this paper shall focus on countries that saw substantial changes in their political economy in the form of a movement away from a centrally planned economy administered by a communist party.

[9] Countries that have made significant moves to embrace the market, even if they have retained a formally communist party leadership (i.e. China or Vietnam) will be treated as 'formerly communist' in what follows. The emphasis here is the changing nature of production decisions, rather than the retention of formal political power by the party.

question in these cases is not whether such changes had an impact on growth in manufacturing trade, but rather whether there was a *differential* impact of such changes on trade in intermediate inputs, relative to other complex goods. We shall explore this hypothesis using international trade data. The idea is to investigate whether or not these countries have been especially important in the trade in parts.

Hypothesis four: One argument about the growth of global production fragmentation (as well as vertical specialization) is that they have been driven by reductions in trade costs. Formal evidence on trade costs lies in many places, but this information is only linked directly to trade flows in a few countries' data sets. The United States is a large country that trades with most other countries in the world. As such, U.S. import data provides information on tariff and freight cost margins across a wide variety of source countries. We shall investigate the wedge between import prices at foreign ports and their destination ports in the United States. The key question is whether there has been a differential effect of these trade cost reductions on trade in parts, and if so, whether that has produced relatively larger growth in imports in those commodities.

Changing input-output relationships

In this section we employ the OECD's cross-country data on input-output relationships to evaluate hypotheses about the role of specific services in the growth of international outsourcing. The OECD data are useful because they provide a common format for representing national production structures across a wide variety of countries.[10] This common format allows an opportunity to identify common changes in production structure across a large set of manufacturing sectors in a large number of industries.

The input-output tables produced by the OECD are fairly aggregated; they report information for only 48 sectors. 22 of these constitute manufacturing sectors producing tradeable goods.[11] For each of the 48 sectors, the tables report the value of intermediate inputs used (both those that are imported and those that are purchased from domestic sources). The tables also supply information on the use of particular services in each industry.

The sectors that are most relevant to the Jones and Kierzkowski (1990) framework are sectors 33 (Land Transport), 34 (Water Transport), 35 (Air Transport), 37 (Post and Telecommunications) and 41 (Computer and related activities). These sectors are plausible candidates as key service sectors involved in the coordination and amalgamation of manufacturing activities from around the globe. These are also sectors that have seen both sizable innovations, as well as major investments that might plausibly align with the Jones and Kierzkowski (1990) theory. Innovations include the growth and spread of the internet in computing and telecommunications, and major developments in logistics such as containerization and the adoption of computing- and communication-intensive 'just-in-time' manufacturing. These innovations required substantial new investments in recent

[10] The countries included in the OECD database are the developed country members of the OECD, as well as several large low- and middle-income economies. The sample employed in the estimation is limited to those countries with a table in 1995 as well as a table in either 2004 or 2005.

[11] The supply of utilities such as electricity, gas and water are excluded from the analysis, even though these sectors, especially electricity generation, might be considered manufacturing under some definitions. The tradability of the output of such sectors is limited, and highly dependent on the specific geography of each country.

decades, including the laying of transoceanic fibre-optic cables and the retrofitting of ports to allow container traffic.

If the nominated sectors are complementary to international production fragmentation, then one might expect to see that manufacturing industries that increase their use of these sectors as inputs relatively more would have relatively larger increases in their use of imported intermediate inputs. In particular, we might expect to see industries with relative growth in the use of these sectors expand their use of imported inputs relatively more.

One of the key limitations of input-output tables for this purpose is that they report information solely in value terms. Large reductions in the prices paid for particular services may be masked in these tables, if industries increase the quantity purchased of the service as prices decline. The hypotheses are thus framed in relative terms. Given a change in the price of one of these services, the assumption is that industries that have relatively larger shifts toward the use of these services are purchasing larger relative quantities of those services. If such services are complementary with imported inputs, these sectors will shift more towards the use of imported intermediate inputs.

The empirical exercise conducted here evaluates changes in the production structure between 1995 and 2005. All countries in the database that have a 1995 table and a 2004 or 2005 table are included in the exercise.[12] The country coverage includes most of the OECD membership, as well as a selection of large developing countries and Israel.[13]

The empirical specification is as follows:

$$m_{ckt} = f_c + f_k + \beta_s s_{ckt} + \beta_T Time + u_{ckt} \qquad (1)$$

where m_{ckt} is the share of imports in intermediate purchases by manufacturing industry k in country c at time t, f_c and f_k are country and industry fixed effects, s_{ckt} is the cost share of a particular service activity, $Time$ is a dummy variable that takes the value of zero for 1995 and one for 2005, and u_{ckt} is a normally distributed error term. The coefficient β_T captures the average conditional change in import shares (across countries and industries). The coefficient β_s links changes in the input cost share of each respective service activity to the increasing reliance of manufacturing industry k on imported intermediates.[14]

We run the regression specified in (1), using each of four candidate variables as the independent variable of interest. Computers and related activities, post and telecommunications, and transportation are all service sectors that are potentially involved in the coordination/amalgamation of activities. We include the cost share of each service

[12] Belgium and Israel are the only two countries in the sample with 2004, rather than 2005, data.

[13] The countries with data that are included in the exercise are Austria, Belgium, Brazil, Canada, China, Denmark, Finland, France, Great Britain, Germany, Greece, Indonesia, Israel, Spain, Italy, Japan, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovakia, Sweden, and the United States.

[14] According to the theory of Jones and Kierzkowski (1990), industries are able to decrease costs by sourcing lower cost inputs from abroad, but must purchase more services in order to take advantage of those opportunities. Thus increased purchases of the service activity are taken to be necessary for increases in international sourcing.

activity in gross output (GO) as the independent variable in (1). We also employ the share of industry transportation expenditures that go to air transport as an independent variable. This evaluates the hypothesis that air transportation is a critical input in production fragmentation.

Before turning to the results, we report the conditional means of each variable of interest in Table 1. All of the service sectors of interest increase their share of output, on average, over time. In the case of transport, the increase is within rounding error. The mean of the air share of transport falls in this sample, perhaps in part because of significantly higher fuel prices in the later years.

Table 1: Conditional mean values of variables across countries and industries

Variable	1995	2004/5
Imported share of inputs	0.303	0.361
Computer and related activity share of GO	0.004	0.006
Post and Telecommunication share of GO	0.006	0.007
Transportation share of GO	0.021	0.021
Air share of transportation	0.147	0.132

Data taken from OECD input output tables.
'GO' indicates gross output.

The results of the estimation based on the econometric specification in equation (1) appear in Table 2. There is little evidence here to support the idea that key service sectors have driven the growth in intermediate input trade. Positive and statistically significant coefficients on the Time dummy indicate growth in the intermediate input share that is orthogonal to the changes observed in the use of sectors of interest. Only one of the variables (the share of post and telecommunications in output) has a statistically significant coefficient attached to it, and that coefficient is negative. This means that industries that saw relatively slower growth in their use of the post and telecommunications sector saw larger growth in the intermediate share of inputs. The remaining variables also had negative signs, counter to expectations, though these were not statistically different from zero.

Subsequent analysis will focus on 'complex goods' as a particularly interesting subset of manufacturing in which to evaluate fragmentation. As a robustness check, the sample was limited to OECD industries 14-24 and 10, which excludes heavy industry from the manufacturing sample. Results were similar to those that appear in Table 2. There is no evidence to suggest that industries that increased their intermediate input shares were those with relative increases in their use of nominated service sectors.

Table 2: Imported input shares and services use 1995-2005

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Time = 2005	0.06***	0.07***	0.06***	0.04***	0.04***	0.05***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
Computer share of GO		-1.18				-0.82
		(0.970)				(1.023)
Telecom share of GO			-2.96***			-2.74**
			(0.807)			(1.116)
Transport share of GO				-0.14		-0.26
				(0.389)		(0.406)
Air share of transport					-0.07	-0.04
					(0.045)	(0.045)
Constant	0.39***	0.40***	0.41***	0.41***	0.41***	0.43***
	(0.013)	(0.013)	(0.013)	(0.017)	(0.015)	(0.019)
Observations	881	786	880	719	719	695
R-squared	0.693	0.696	0.702	0.729	0.731	0.745

Dependent variable is imported share of intermediates purchased by manufacturing industry, country, year triplets.
Estimates include industry and country fixed effects.
Standard errors in parentheses
*** p<0.01, **p< 0.05, * p<0.1

Discussion

It is difficult to formally evaluate the hypotheses put forward by Jones and Kierzkowski (1990). They rely on complementarity between imported inputs and the amalgamating/coordinating sector. Were we to observe relative input prices and firm level behavior, we might be able to identify such changes closely. Even then, we would likely have to rely on input prices (for services especially) that vary with quality, and are difficult to measure.

The method identified above suggests a plausible test of substitution possibilities. Since developments in the service sectors of interest had global impact, the large amount of cross-country variation available in the multi-country input-output tables offered a chance to observe common changes across countries. The relatively aggregated nature of the industry flows, however, make clear assessments difficult. Substitution possibilities occur at the firm level, and what is observed here are highly aggregated industries. Automotive equipment, for example, is a single sector in these tables, including many complex staging possibilities and component parts. Sector-level analysis treats all firms within this industry as if they responded to relative price changes in equivalent ways.

Evidence from international trade flows

International production fragmentation involves two types of changes that are difficult to observe jointly in the data: national production structures change, as do trade flows. One of the difficulties associated with assessments of changing production

structures is that production data that are compatible across countries are typically quite aggregated. International trade data, on the other hand, offer considerably more detail.[15] The key question pursued here is how trade in parts differs from trade in other complex goods.

The trade data employed here are bilateral trade data collected by the United Nations Conference on Trade and Development (UNCTAD), and maintained by the World Bank using the World Integrated Trade Solution (WITS) software. The data considered here are from the years 1996, 2002, and 2008.[16] 1996 is the first year that the data is available through WITS.[17] The data contain product detail at the HS6 level of aggregation.

In order to identify trade in parts, we employ a classification developed alongside the BACI data (Gaulier and Zignago (2009)). The classification is based on the United Nations' Broad Economic Categories. Each HS6 category is assigned to one of 5 groups: Parts and accessories, Consumption goods, Capital goods, Primary goods, and Processed goods. The focus of attention in this paper is the parts and accessories category.[18] This category of goods is compared against a broader grouping, labeled *complex goods*. For the purposes of the exercises in this section of the paper, complex goods will include all those in the three BACI categories: Consumption goods, Capital goods, and Parts and accessories. These goods are grouped together because they are relatively late stage in production, include multiple inputs, and are relatively footloose in terms of their natural resource requirements. In the absence of production fragmentation, parts and accessories would be expected to be produced in the same location as final goods in the capital and consumption goods categories.

We begin with an illustration of the cross-country distribution of parts trade. This information is displayed in Figure 1. The share of parts in complex goods exports is displayed along the vertical axis. The horizontal axis measures exporter size, using the (log of) total export value as the indicator of interest. Larger exporters tend to export more parts as a share of their complex goods exports. The outlier 'KNA' at the top of the figure is St Kitt's and Nevis. The high degree of parts trade in East Asia is also evident in the upper right hand of the figure. Many of these countries would also export a significant amount of capital and/or consumption goods, so the relatively large parts share displayed in the figure is notable.[19]

The purpose of this section is to attempt to explain variation in parts trade across countries and over time. In order to identify specific forces driving parts trade, the method must control for other explanations for variation in trade flows. One method of control is to also track changes in a broader set of complex goods.

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[15] The primary difficulty with international trade data for an exercise like this one is that the end use of imported goods must be inferred, whereas input-output tables can distinguish between purchases by firms and purchases by consumers. External assessments of the likely end use of each commodity are used as inputs into what follows.

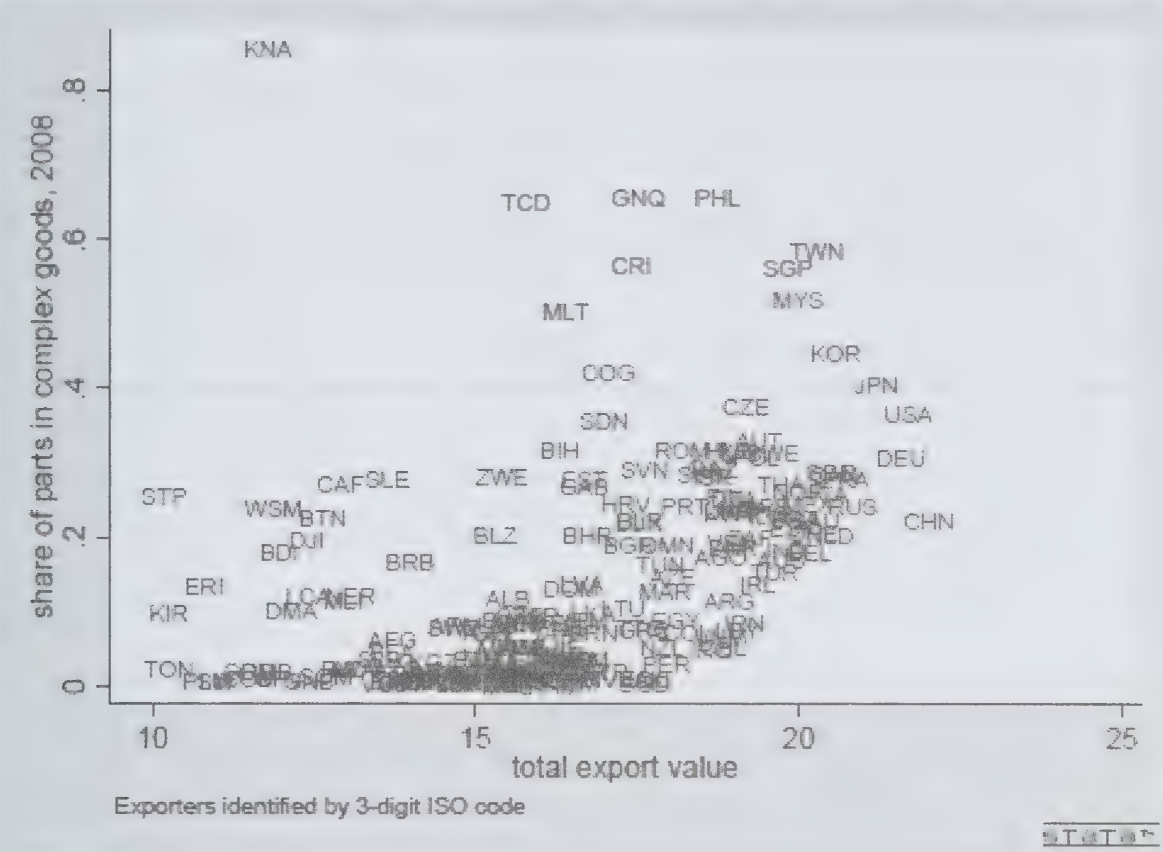
[16] Bilateral flows at the product level implies very large quantities of data. We limit the size of the problem by using data from selected years.

[17] Longer time series are available in the data collected by Feenstra et al. (2005), but these data end in the year 2000, and report product information in a more aggregated format.

[18] Parts and accessories are referred to as 'parts' throughout, including references to classifications.

[19] For a detailed discussion of parts trade in East Asia, see Athukarola (2006).

Figure 1: Share of parts in complex exports against exporter size, 2008



The primary analytical tool used here is a decomposition of trade flows, which will be applied to exports and imports in turn.[20] The decomposition for exports is as follows:

$$XP_{it} = \frac{XP_{it}}{XC_{it}} \frac{XC_{it}}{X_{it}} X_{it} \quad (2)$$

where country i's exports of parts at time t is denoted XP_{it}. Variation across time or across exporters can be decomposed, in turn, into movements in the three terms on the right hand side of (2). The first term on the right, $\frac{XP_{it}}{XC_{it}}$, measures the share of parts in total complex goods exports from i at time t, XC_{it}. The second term, $\frac{XC_{it}}{X_{it}}$, measures the share of complex goods exports in total exports from i at time t, X_{it}. The third term captures movements in total exports. It is the first term in this decomposition that is of interest. Changes in this ratio indicate differential changes in parts trade, distinct from broader changes in the trade of complex goods.

The method for what follows is to regress (the natural log) of the left hand side of (2) on independent variables of interest, and then regress the natural log of each of the components of the right hand side on those same variables. The coefficient from the left hand side regression explains how total parts trade relates to the independent variables.

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[20] The decomposition originated in Hummels and Klenow (2005). Hillberry and Hummels (2008) and Bernard et al. (2007) applied it to spatial variation in trade flows. Hillberry and McDaniel (2002) applied the technique to bilateral changes over time in trade flows.

The coefficients from the right hand side regressions explain whether such movements are particular to parts trade, or common across a broader set of goods.

The initial exercise involves a series of single-period cross-section regressions using data from 1996, the first year of the sample. Three independent variables of interest are included: log per capita GDP, log population, and a dummy variable indicating if the country is a formerly communist country.[21] Per capita GDP offers a crude indicator of the relative availability of capital and skilled labor.[22] As relatively complex goods, one might expect that parts would be produced in relatively rich countries. The population variable measures country size, after controlling for per capita income. If either internal or external scale economies are important in parts production, one might expect to see large countries exporting parts.[23] The inclusion of a dummy variable indicating formerly communist countries reflects the idea that new entrants into the global marketplace may have brought new factor bundles that facilitate trade in tasks.[24] The results of these regressions appear in Table 3. Note that our decomposition structure ensures the coefficients from columns 2-4 sum to the coefficient in column 1, within rounding error.[25]

The results in the first column of Table 3 indicate that exports of parts are increasing in per capita income and country size. Formerly communist countries export significantly more parts than other countries, after controlling for per capita income and country size. The results in column 4 offer a useful comparison, as these coefficients define the effects of the same variables on total exports. Total exports are less responsive to per capita income and size than are exports of parts. Formerly communist countries export less in total than other countries, after controlling for size and per capita income.

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[21] The countries included in this group are Afghanistan, Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Cambodia, China, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Laos, Latvia, Lithuania, Macedonia, Moldova, Montenegro, Poland, Romania, Russia, Serbia, Slovak Republic, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan and Vietnam.

[22] We employ per capita GDP from 1995 as a regressor for 1996 trade flows. GDP is endogenous to exports, so we use data from the year prior as our exogenous measure of per capita GDP.

[23] One might normally expect to see GDP enter alone as an indicator of market size, offering no distinction between large low-income countries and small high-income countries. Here we are we using the ratio of GDP/population as an income measure, and population as the country size measure.

[24] The inclusion of China in East Asian parts markets, as well as the shifting of parts production activities from Western to East Central Europe, are anecdotally important changes in parts and accessories trade. The exhaustive list of formerly communist countries is meant to assess whether such anecdotes consistent with a broader story about the entry of new markets into the world trading system. The entry of such countries into global markets allows new 'production blocks' in the language of Jones and Kierzkowski (1990), and this offers a test to see if those new entrants are especially important for parts trade.

[25] This structure facilitates a convenient decomposition of the effects summarized by the coefficients in column 1. Consider the coefficients on log per capita GDP in columns 1 and 2 as an example. $\frac{0.63}{2.47} = 0.27$ implies that 27 percent of the response of total parts trade to per-capita GDP is due to the fact that the share of parts and accessories in complex goods rises with per capita GDP. Such thought exercises can be done with any of the coefficients in columns 2-4.

Table 3: Decomposition of exports, across countries, 1996

	(1)	(2)	(3)	(4)
Variables	$\ln(XP)$	$\ln\left(\frac{XP}{XC}\right)$	$\ln\left(\frac{XC}{X}\right)$	$\ln(X)$
Per capita GDP, 1995	2.37***	0.63***	0.32***	1.41***
	(0.121)	(0.086)	(0.078)	(0.099)
Population, 1995	1.15***	0.26***	-0.06	0.94***
	(0.062)	(0.055)	(0.037)	(0.034)
Formerly communist	0.76***	0.65***	0.38*	-0.27*
	(0.243)	(0.167)	(0.196)	(0.152)
Constant	-19.37***	-10.54***	-3.52***	-5.31***
	(1.246)	(0.941)	(0.716)	(1.006)
Observations	179	179	179	179
R-squared	0.834	0.337	0.112	0.861

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Columns 2 and 3 of Table 3 illustrate how total exports and parts exports differ across these three independent variables. The share of complex goods in total exports is rising in a country's per capita income. There is relatively little evidence that complex goods exports differ from total trade with respect to country size and the formerly communist dummy. The most notable differences between parts trade and total trade are illustrated in column 2, where each of the variables of interest has a large positive and statistically significant coefficient. Each of these independent variables predicts relatively more parts exports than exports of other complex goods.

The statistical and economic significance of the coefficient on the formerly communist dummy in column 2 is notable. These data are for 1996, just 7 years after the fall of the Berlin Wall, and only 5 years after the collapse of the Soviet Union. Chinese market reforms took place over a longer period, but were only firmly in place by the early 1990s.[26] Yet already in the 1996 data, formerly communist countries were unusually large exporters of parts. Furthermore, it seems that there is something unusual about parts, since they are relatively more important in exports from these countries than were exports of other complex goods.[27]

[26] Deng Xiaoping's 'southern tour' is a notable landmark in Chinese economic reforms. That event took place in 1992.

[27] Note that while China undoubtedly has a large economic role in parts and accessories trade, the regression procedure here allows relatively little influence of China in a statistical sense. It is just one of 33 countries for which the dummy variable takes the value of one. As such, its influence on the regression is rather small.

Table 4: Decomposition of imports, across countries, 1996

	(1)	(2)	(3)	(4)
Variables	$\ln(MP)$	$\ln\left(\frac{MP}{MC}\right)$	$\ln\left(\frac{MC}{M}\right)$	$\ln(M)$
Per capita, GDP995	1.65***	0.12***	0.07***	1.46***
	(0.067)	(0.030)	(0.015)	(0.048)
Population, 1995	0.92***	0.13***	-0.03***	0.82***
	(0.038)	(0.017)	(0.011)	(0.024)
Formerly communist	-0.29*	-0.08	-0.20***	-0.01
	(0.160)	(0.092)	(0.056)	(0.093)
Constant	-9.01***	-3.79***	-0.89***	-4.33***
	(0.599)	(0.289)	(0.135)	(0.480)
Observations	113	113	113	113
R-squared	0.920	0.407	0.347	0.953

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

The results for an equivalent exercise on imports is reported in Table 4.[28] In these regressions variation in overall trade is linked more closely to trade in parts. The coefficient estimates in columns 1-4 are quite similar. Nonetheless, there remains some interesting variation revealed in columns 2 and 3. The share of complex goods in total imports is rising in per capita income, and falling in population size, though these effects are not large. Formerly communist countries are less likely to import complex goods than other countries. The share of parts in complex goods in parts is also rising in per capita income and population size.

The evidence from Table 3 indicates that in the period following significant changes in political economy in formerly communist countries, parts became an important part of these countries' exports by 1996. The next set of exercises looks at subsequent changes in the pattern of trade. One might imagine production fragmentation involving new market participants as a one-time shift that had been completed by around 1996. If these countries are as important for production fragmentation as the previous regressions indicate, then a key question is whether production fragmentation continued after 1996, or if the transition into significant parts trade had already been completed by then.

Once again the decomposition in (2) is the central empirical tool, along with its counterpart for imports. This time the sample includes data from two later years, 2002 and 2008.[29] The regression specification includes time dummy variables, as well as fixed effects

[28] The data used here are those that importers reported to UNCTAD. (Data reported by importers are often better than data reported by exporters because import tracking is linked to traditional mechanisms for collecting tariff revenue.) The use of importer reported data means that there are fewer importers observed in these data than there are exporters. Countries which are not reporters to UNCTAD are observed as exporters in these data, but not as importers. Such countries are typically quite small participants in global trade.

[29] In order to control for US dollar inflation, the figures here are deflated by the US import price

that control for country-specific averages over time. The regressions employed here indicate whether, across the sample, countries observed significant changes in the composition of their exports, on average.

Table 5: Decomposition of exports, 1996-2008

	(1)	(2)	(3)	(4)
Variables	$\ln(XP)$	$\ln\left(\frac{XP}{XC}\right)$	$\ln\left(\frac{XC}{X}\right)$	$\ln(X)$
Year = 2002	0.57***	0.14*	0.06	0.37***
	(0.082)	(0.076)	(0.046)	(0.058)
Year = 2008	1.45***	0.29***	-0.22***	1.37***
	(0.087)	(0.082)	(0.057)	(0.068)
Constant	9.53***	-2.88***	-1.20***	13.61***
	(0.065)	(0.059)	(0.038)	(0.048)
Observations	687	687	687	687
R-squared	0.968	0.816	0.895	0.973

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Country level fixed effects included in all regressions.

Results for exports are reported in Table 5. Both parts trade (column 1) and overall trade (column 4) grew substantially during the period. Coefficients on the *year=2008* dummy indicate that complex goods fell as a share of exports in the average country, but parts as a share of complex goods exports rose. This is consistent with a story of ongoing product fragmentation. These effects are not large however. Variation in parts trade barely exceeded growth in overall trade. The overall conclusion is that, in the typical country, parts exports did not substantially outpace overall export growth in the years 1996-2008.

Table 6 reports the results of similar regressions using country level imports. In this case, the cross country average imports of parts grew slightly more slowly than overall trade. There is very little evidence to suggest that the trade in parts or complex goods had notably different time paths.

index for manufactured goods, excluding petroleum, which is available from the US Bureau of Labor Statistics.

Table 6: Decomposition of imports, 1996-2008

	(1)	(2)	(3)	(4)
Variables	$\ln(MP)$	$\ln\left(\frac{MP}{MC}\right)$	$\ln\left(\frac{MC}{M}\right)$	$\ln(M)$
Year = 2002	0.25***	-0.03	0.02	0.26***
	(0.051)	(0.026)	(0.017)	(0.034)
Year = 2008	1.06***	-0.05*	-0.08***	1.19***
	(0.058)	(0.027)	(0.019)	(0.039)
Constant	13.02***	-1.63***	-0.63***	15.28***
	(0.042)	(0.021)	(0.014)	(0.027)
Observations	412	412	412	412
R-squared	0.988	0.925	0.816	0.992

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Country-level fixed effects included in all regressions.

Discussion

One of the implications of the Jones and Kierzkowski (1990) framework is that the emergence of new trading possibilities makes possible increased production fragmentation. Economic reform in centrally-planned economies in in Eastern Europe and in Asia generated these new possibilities. In most cases, these new market-based economies were geographically close to developed country markets, so that developed countries could offshore parts activities at relatively low cost. Evidence from multinational trade data suggests that these new market economies export relatively more parts, as a share of complex goods, than other countries that are of similar sizes and levels of development. This appears to have been true as early as 1996, which is the initial year of the data employed here.

One of the questions of interest to policymakers will be whether the episode of product fragmentation that was observed in recent decades was a single large event, or is a process that is likely to continue unabated. Evidence from the international trade data suggests that trade in parts did not exceed general trade growth following 1996. This would be consistent with the view that the opportunities for product fragmentation that arose due to political economy reforms in former communist countries were seized quickly.

As indicated above, recent decades have also seen economic reforms in countries other than those identified here as formerly communist. For example, India has embarked on significant economic reforms, as have large parts of Latin America. It is likely that such reforms also increased the size of the global marketplace. It is difficult to evaluate such reforms, or to identify as easily the countries participating in them.[30] The role of other, non-communist reforming countries in global parts trade is left to future work.

[30] Trade reforms may be visible as tariff cuts, but one might also wish to identify significant changes in ownership, investment and competition policies, for example, that allowed deeper integration into global marketplaces.

Evidence from U.S. trade data

This section reports the results of an exploration of U.S. trade data over the period 1989-2008.[31] The questions investigated benefit from a number of details available in U.S. data that are not available in cross-country data sets, nor in many other single-country data sets. The U.S. data include information on shipment mode, which allows us to look for growing differences across goods and over time in the use of air transportation. Information on freight charges and tariffs allows an evaluation of changes in relative trade costs over the period. The U.S. data also report a finer level of product classification than is available in cross country data. An end-use classification in U.S. data allows us to separate parts from other trade at this more detailed level.

The identification strategy is similar to that followed in the previous section. The primary analytical tool is a decomposition that distinguishes between parts and other complex goods.[32] This isolates movements in aggregate parts trade from trade in other goods of similar complexity. Within the U.S. sample, most of the exercises will focus on within-country changes over time in the pattern of exports to the United States.

Changes in trade costs facing U.S. imports, 1989-2008

One of the key advantages of the U.S data is that includes good measures of trade costs. Information about duty collections is reported alongside the value of shipments. The U.S. data also includes direct measures of customs, insurance and freight (cif) charges. We begin the analysis of the U.S. data by calculating *ad valorem* tariff and cif rates for every country-commodity pair.[33] In order to see how relative trade costs have changed, we report the median value of these in 1989, for parts, and for all complex goods. The results appear in Table 7.

Table 7: Median charges: commodity-country pairs in U.S. imports

Trade Cost	Year	Parts	Complex
Customs, insurance and freight	1989	0.031	0.044
Customs, insurance and freight	2008	0.028	0.042
Duties	1989	0.036	0.046
Duties	2008	0.000	0.017

Trade costs measured on an ad valorem basis.
Complex goods in SITC 5-8.

Trade cost reductions appear in both cif charges, and in *ad valorem* tariffs. Both parts and complex goods saw notable reductions in duties, while the cif charges fell by much less. Measured in levels, *ad valorem* duties fell more amongst parts than amongst complex goods more generally. In the case of parts, the median *ad valorem* duty falls all the way to zero for parts trade, while in complex goods some duties remain.[34] It may be that moving

[31] The data are annual figures from *U.S. Imports for Consumption* published by the U.S. Census Bureau.

[32] Complex goods in these exercises are defined as commodities in SITC categories 5-8. Parts are defined by the U.S. end use classification. End use categories 2 and 3 are included, with exceptions for those subcategories that identify final capital or consumer goods.

[33] Commodities defined at the HS 8 level of disaggregation.

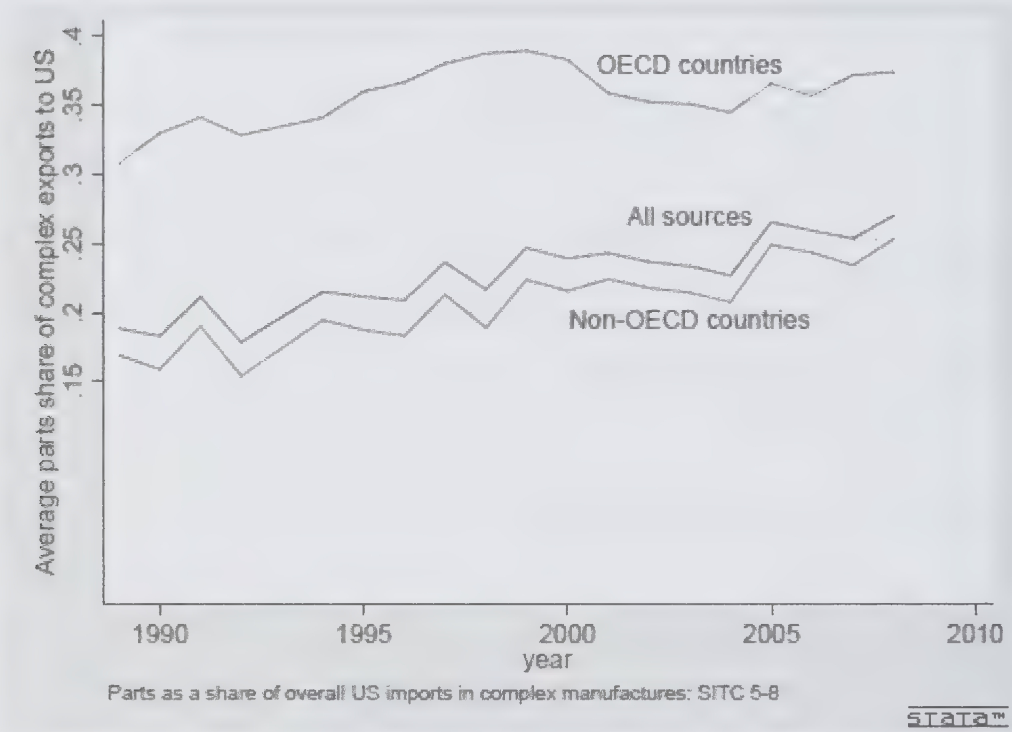
[34] The median duty for parts reached zero in the year 2000.

towards a zero tariff across a large group of parts was important for increasing trade flows.

Sources of U.S. parts imports

This subsection provides some short historical background on the evolution of U.S. parts imports over the period of interest. The purpose is to demonstrate movements over time in parts imports, as compared with imports of other complex goods. Each country's share of parts in complex exports to the U.S. is calculated, and this share regressed on a vector of country-specific fixed effects and annual year dummies. This exercise is also conducted for OECD countries and for non-OECD countries. The fitted values are plotted in Figure 2.

Figure 2: Fitted values of regression of share of exports in each country on annual dummy variables.



The central line in the figure captures movements over time in the average share of parts in countries' exports of complex goods to the U.S. This share is rising over much of the sample, from 0.19 in 1989 to 0.26 in 2008. The top line in the figure reveals that the high income countries in the OECD tend to have much larger shares of parts in their complex goods exports than does the average country. This is consistent with the earlier regression analyses linking per capita income to rising parts shares in multi-country data. Much of the growth in OECD parts shares in exports to the U.S. seems to have occurred in the 1990s. The lower line captures movements in the average share of parts for non-OECD countries, which moves in tandem with that of the typical country, but sits somewhat below the average.[35]

[35] In each case, the difference between the parts share at the end of the sample and at the beginning is highly statistically significant. A similar exercise for U.S. imports from formerly communist countries also demonstrated growth in the parts share post-1991, but the series is volatile, and has relatively large standard errors, so it is not shown here.

Within-commodity movements

The next exercise uses U.S. imports in complex goods as a benchmark against which to evaluate changes in the volume and nature of U.S. parts imports over time. Rather than aggregate across commodities into countries, as we did for the figure, in this set of exercises we aggregate across countries to the commodity level. We hope to capture average, within-commodity changes, in U.S. imports, and evaluate them in a useful decomposition. The decomposition appears as follows:

$$V_{it} = N_{it}\overline{PQ}_{it} = N_{it}\overline{Q}_{it}P_{it} \qquad (3)$$

where N_{it} represents the number of countries exporting commodity i to the U.S. at time t, $\overline{PQ}_{it} = \frac{V_{it}}{N_{it}}$ represents the average value of country exports, $\overline{Q}_{it}$ is the average quantity per country that is exported, $\frac{Q_{it}}{N_{it}}$, and P_{it} is the average unit price, $\frac{V_{it}}{Q_{it}}$, inclusive of duties and cif charges.

The logged terms in (3) are each regressed on a dummy indicating whether the HS8 commodity has been designated as a part, year dummies throughout the sample, and an interaction of the part and year dummies. This allows us to see average within-commodity movements over time, in U.S. imports, and to contrast the movements of parts imports with those of complex goods as a whole.[36]

The results of these exercises are reported in Table 8. In column 1, we see that the value of U.S. complex goods imports in a given commodity has risen over the period, as is clear from the positive and statistically significant coefficients on the year dummy variables. Further down the column, the interactions of the part and year dummies are also significant and positive, which indicates that the value of U.S. parts imports has grown more quickly than the value of other complex imports.

Column 2 demonstrates that approximately one-third of the increase in the value of complex goods imports into the U.S. has occurred because the U.S. now imports each product from more countries. Parts trade is not notably different, although in the period 2005-2008, the average number of source countries rises among parts while falling amongst other complex goods, generating a small but significant difference. Column 3 illustrates that most of the growth in average import value occurred because of growth in the average value shipped by each country. The average value per country grew faster among commodities identified as parts than among other complex goods.

Columns 4 and 5 offer a further dissection of the changes in the movements of column 3. Among all complex goods, unit prices and average quantities rise together. This suggests an increase in demand for imported complex goods. Against that baseline, there appear to be no significant relative price movements for parts. Rather, the relative increase in the average value of parts trade appears to arise as the result of increasing average quantities. If the entry of cheap new sources of parts supply were a dominant feature of the data, one might have expected to see relative parts prices fall. If new technological improvements allow higher quality parts to be produced overseas, one might have expected unit prices to have risen. The lack of definitive within-commodity price

[36] All dollar values are deflated by the U.S. producer price index in manufacturing.

movements, relative to other complex goods, suggests that such effects might be offsetting.[37]

Table 8: Changes in US Imports of Complex Goods, 1989-2008

Variables	(1) $\ln(val_{it})$	(2) $\ln(N_{it})$	(3) $\ln(\overline{PQ}_{it})$	(4) $\ln(\overline{Q}_{it})$	(5) $\ln(P_{it})$
part = 1	3.70***	0.82***	2.89***	3.05***	-0.16***
	(0.047)	(0.015)	(0.042)	(0.053)	(0.032)
year = 1995	0.33***	0.10***	0.23***	0.11***	0.12***
	(0.017)	(0.006)	(0.016)	(0.020)	(0.012)
year = 2000	0.61***	0.24***	0.38***	0.36***	0.02*
	(0.017)	(0.006)	(0.016)	(0.020)	(0.012)
year = 2005	0.83***	0.30***	0.54***	0.49***	0.04***
	(0.017)	(0.006)	(0.016)	(0.020)	(0.012)
year = 2008	0.89***	0.27***	0.63***	0.37***	0.26***
	(0.018)	(0.006)	(0.016)	(0.020)	(0.12)
part = 1 & year = 1995	0.00	0.00	0.00	-0.05	0.05*
	(0.042)	(0.014)	(0.037)	(0.047)	(0.029)
part = 1 & year = 2000	0.16***	0.01	0.14***	0.11**	0.03
	(0.041)	(0.014)	(0.037)	(0.047)	(0.028)
part = 1 & year = 2005	0.12***	0.02	0.09**	0.10**	0.00
	(0.041)	(0.014)	(0.037)	(0.047)	(0.028)
part = 1 & year = 2008	0.26***	0.06***	0.19***	0.20***	0.00
	(0.042)	(0.014)	(0.038)	(0.048)	(0.029)
Constant	14.66***	2.21***	12.45***	9.74***	2.71***
	(0.014)	(0.005)	(0.013)	(0.016)	(0.010)
Observations	128778	128778	128778	128778	128778
R-squared	0.888	0.903	0.855	0.914	0.956

Estimates include commodity fixed effects at the HS8 digit level.
Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

[37] Unit prices reported in column 5 are gross of duties and cif costs. Reductions in these costs over time, as reported in Table 7 imply that source country prices are rising somewhat faster than is observed in column 5. The relative difference in trade cost changes are not large enough, however, to imply substantial relative changes in parts price movements, as compared with movements of prices of other complex goods.

Parts imports and high speed shipments

Hummels (2007) surveys changes in transportation costs, and finds a key notable change in recent decades is the reduction in the costs of air shipments (in absolute terms, and relative to other transportation costs). If such changes are important to the growth of intermediate goods trade, one might expect to see that reflected in shippers' choice of transport mode. This section exploits the information on mode choice within the U.S. trade data to identify *relative* changes in the mode choices of parts trade. Once again, we employ the decomposition outlined above. In this case, we adopt a relative comparison that jointly evaluates the characteristics of shipments moving by air and by sea.[38]

The exercise is once again framed in relative terms. The question is whether parts trade has become more dependent on air shipments. Once again, these movements are judged against movements in other complex goods, so that the evidence of changes in parts trade is compared against a meaningful set of products acting as a control group. An initial calculation derives the relative value of shipments by air and sea at in commodity i at time t. This ratio can be regressed against part and year dummies, as well as interactions between the two, in order to investigate common movements in the ratio of air to sea shipments. Ratios of a decomposition allow further investigation into the nature of changes across the relative mode choices.

The decomposition follows that observed in (3), although it does so in relative terms. The form of the decomposition is as follows:

$$\frac{V_{it}^{air}}{V_{it}^{sea}} = \frac{N_{it}^{air}}{N_{it}^{sea}} \frac{\overline{Q}_{it}^{air}}{\overline{Q}_{it}^{sea}} \frac{P_{it}^{cif-air}}{P_{it}^{cif-sea}} \tag{4}$$

where $V, \overline{Q}$, and P are defined as above, with *air* and *sea* superscripts indicating mode of shipment. Prices are calculated gross-of-trade costs P_{it}^{cif} and net of trade costs P_{it}^{fob}, in order to evaluate relative movements in tariff and cif costs. A regression using relative prices measured at the origin ports, P_{it}^{fob} is included for comparison purposes. The results appear in Table 9.

Column 1 indicates that the relative value of air and sea shipments in complex manufactures fluctuated over the period, rising initially and then falling. These moves can be explained in part by movements in fuel costs, which were relatively stable over the period 1989-2000, and rising thereafter. Among the commodities in the parts category, the relative quantity of air shipments rose, offsetting the decline in the ratio for complex goods that occurred post-2000. This evidence suggests that parts trade shifted more heavily in to air shipment than did other complex goods.

[38] Overland shipments to the United States are dominated by shipments from Canada and Mexico. The time required for such shipments is ambiguous, as the U.S. trade data do not say how far the shipments are travelling (in the U.S. or inside the respective trading partner). For these exercises we discard shipments from Canada and Mexico, looking only at air and sea shipments from non-NAFTA partners.

Table 9: Relative changes, air versus sea shipments, US Imports, 1989-2008

	(1)	(2)	(3)	(4)	(5)
Variables	$\ln\left(\frac{V_{it}^{air}}{V_{it}^{sea}}\right)$	$\ln\left(\frac{N_{it}^{air}}{N_{it}^{sea}}\right)$	$\ln\left(\frac{\overline{Q}_{it}^{air}}{\overline{Q}_{it}^{sea}}\right)$	$\ln\left(\frac{P_{it}^{cif-air}}{N_{it}^{cif-sea}}\right)$	$\ln\left(\frac{P_{it}^{fob-air}}{N_{it}^{fob-sea}}\right)$
part = 1	0.20***	0.08***	0.04	0.08*	0.07
	(0.071)	(0.024)	(0.075)	(0.047)	(0.049)
year = 1995	0.18***	0.18***	-0.04	0.03*	0.03
	(0.028)	(0.010)	(0.032)	(0.020)	(0.020)
year = 2000	0.26***	0.20***	-0.05*	0.11***	0.13***
	(0.026)	(0.010)	(0.031)	(0.019)	(0.020)
year = 2005	-0.01	0.21***	-0.46***	0.25***	0.26***
	(0.027)	(0.020)	(0.031)	(0.019)	(0.020)
year = 2008	-0.11***	0.25***	-0.58***	0.22***	0.23***
	(0.028)	(0.010)	(0.033)	(0.020)	(0.021)
part = 1 & year =	0.17***	-0.02	0.18**	0.02	0.02
	(0.058)	(0.021)	(0.063)	(0.039)	(0.040)
part = 1 & year =	0.12**	-0.05**	0.17**	0.00	0.00
	(0.056)	(0.020)	(0.060)	(0.037)	(0.038)
part = 1 & year =	0.17***	-0.02	0.26**	-0.07*	-0.07*
	(0.057)	(0.020)	(0.062)	(0.038)	(0.039)
part = 1 & year =	0.14**	-0.08***	0.26**	-0.05	-0.05
	(0.059)	(0.020)	(0.026)	(0.016)	(0.017)
Constant	-2.05***	-0.18***	-3.10***	1.23***	1.14***
	(0.024)	(0.008)	(0.026)	(0.016)	(0.017)
Observations	113485	113485	113485	113485	113485
R-squared	0.821	0.798	0.702	0.542	0.537

Estimates include commodity fixed effects at the HS8 digit level.
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Column 2 indicates that ratio of source countries supplying by air (relative to sea) rose among all complex goods, with little substantive differences relative to parts.[39] Among complex goods, the quantity per country fell as fuel prices rose post-2000. This also occurred among parts, but to a lesser degree. Relative prices gross of trade costs (cif) rose over time for complex goods, with no substantive difference for parts. The same story holds up for relative net of trade cost (fob) prices. Overall it seems that there was a relatively larger shift towards air shipments in parts trade than in complex goods. As fuel prices rose at the end of the period, the shift towards air was more than reversed among complex goods, while parts remained reliant on air shipments as it had been when fuel prices were lower. This suggests that the availability of air shipment possibilities was an important reason for increased trade in parts.

[39] By the year 2008, the relative number of source countries had fallen slightly.

Discussion

Particular features of the U.S. import data allow us to investigate growth in parts trade, and to compare these to other complex goods. Reductions in trade costs were similar across the two categories of goods, although duties fell to zero for many commodity-country pairs in the parts categories. The relative increase in the value of parts imports operates through a relative increase in the quantities of imported parts. Relative price changes are not significantly different across these two categories of goods.

An assessment of relative air versus sea shipments reveals that mode choices moved as might have been expected given fuel cost changes. An initial increase in parts trade occurred in the years 1989-2000, when fuel prices remained fairly constant. As fuel prices rose following 2000, however, complex goods were increasingly shipped by sea, rather than air. This reversion was muted among commodities in the parts category, however. This points to evidence that parts became relatively more dependent on air shipments over this period, when compared with other complex goods.

Conclusion

The reliance of modern manufacturing on integrated international production processes is a phenomena that requires further study. This paper developed a series of hypotheses about the causes of international production fragmentation. Where possible, these hypotheses were taken to the data.

One important theory of production fragmentation puts the coordinating and amalgamating services - such as transport, communications, and information technology - at the center of the discussion. One implication of these theories is that increased reliance on such services is complementary with increased use of imported intermediate inputs. In this paper, the evidence for such complementarity was investigated, with growth in intermediate input use across sectors regressed against growth in those sectors dependence on key service sectors. There does not appear to be convincing empirical evidence in support of this hypothesis. The data, however, are quite aggregated, and not well suited for the task.

Another implication of the theory is that the introduction of new trading partners into the system should facilitate production fragmentation. The question of particular interest in this paper is whether political economic reforms in formerly communist countries might have been responsible for additional production fragmentation. The evidence suggests that those countries are notably dependent on parts in their exports. Even after controlling for size and income levels, it seems that such countries have relatively high shares of complex goods their exports. It also appears, however, that these outcomes were largely determined by 1996. Trade growth in parts since then has been more or less in line with trade growth in other commodities.

U.S. import data suggests modest growth in parts trade, relative to other complex goods. It appears that much of this relative growth has occurred in the form of increasing relative quantities of parts shipped, rather than changes in relative prices or the relative number of source countries. Evidence from shippers' mode choices suggests that parts trade has become relatively more dependent on air shipments than has trade in other complex goods. Rising fuel prices have led complex goods to become less dependent on air shipments, while parts trade was as dependent on air in 2008 as it was in 1989.

In the end, production fragmentation is a multi-faceted phenomenon with many interlocking parts. Data difficulties make it difficult to explain convincingly in unified terms. Evidence presented here suggests that more readily available air transport and the

introduction of new production blocks in Eastern Europe and East Asia may have been important sources of growth in international production fragmentation. While the evidence did not point convincingly to other explanations, the quality of data available for evaluation such stories remains weak.

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International Comparative Evidence on Global Value Chains

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Introduction

The past decades have witnessed a rapid globalisation of economic activity which has significantly changed the outlook of the world economy. An increasing number of firms, countries and other economic actors take part in today's global economy and have become increasingly connected across borders. International production, trade and investments are increasingly organised within so-called global value chains (GVCs) where the different stages in the production process are located across different economies. Intermediate inputs like parts and components are produced in one country and then exported to other countries for further production and/or assembly in final products.

This functional and spatial fragmentation within GVCs is significantly affecting how the global economy operates and has increased the economic interdependency between economies. The increasing importance of intermediates clearly suggests that economies no longer rely only on domestic resources to produce goods and services and export these to the rest of world (Sturgeon and Gereffi, 2009). Countries just like firms increasingly become specialised in specific functions within these GVCs.

The spatial distribution of corporate activities within GVCs has been facilitated by the strong decline in transportation and communication costs (Grossman and Rossi-Hansberg, 2006; Baldwin, 2006). In addition, rapid technological advances in ICT have dramatically decreased the cost of organising and coordinating complex activities over (long) distances. Plummeting costs of processing and transmitting information, organisational innovations and the development of international standards for products descriptions and business protocols have further facilitated the spread of GVCs.

While GVCs have been largely discussed from a conceptual and theoretical view, empirical work on international fragmentation has lagged. The existing evidence is mainly restricted to case study work (e.g. the Barbie doll and the Apple iPod) and industry-specific surveys, but does not depict a more comprehensive picture of the integrated global productions structure. The OECD has recently developed new empirical evidence studying the emergence of GVCs primarily based on harmonised international trade data and Input-Output data[1].

By reviewing the internationally comparable evidence, this paper demonstrates the growing importance of GVCs since 1995 and discusses the differences between economies, industries and goods and services. At the same time, the paper also highlights several shortcomings of existing data and clearly shows the need for new indicators of GVCs. Important policy issues like the impact of GVCs on the competitiveness of

[1] This paper is among others based on the empirical evidence presented in OECD (2010) 'Economic Globalisation Indicators'.

countries and attractiveness for international investments can only be addressed by new and better metrics.

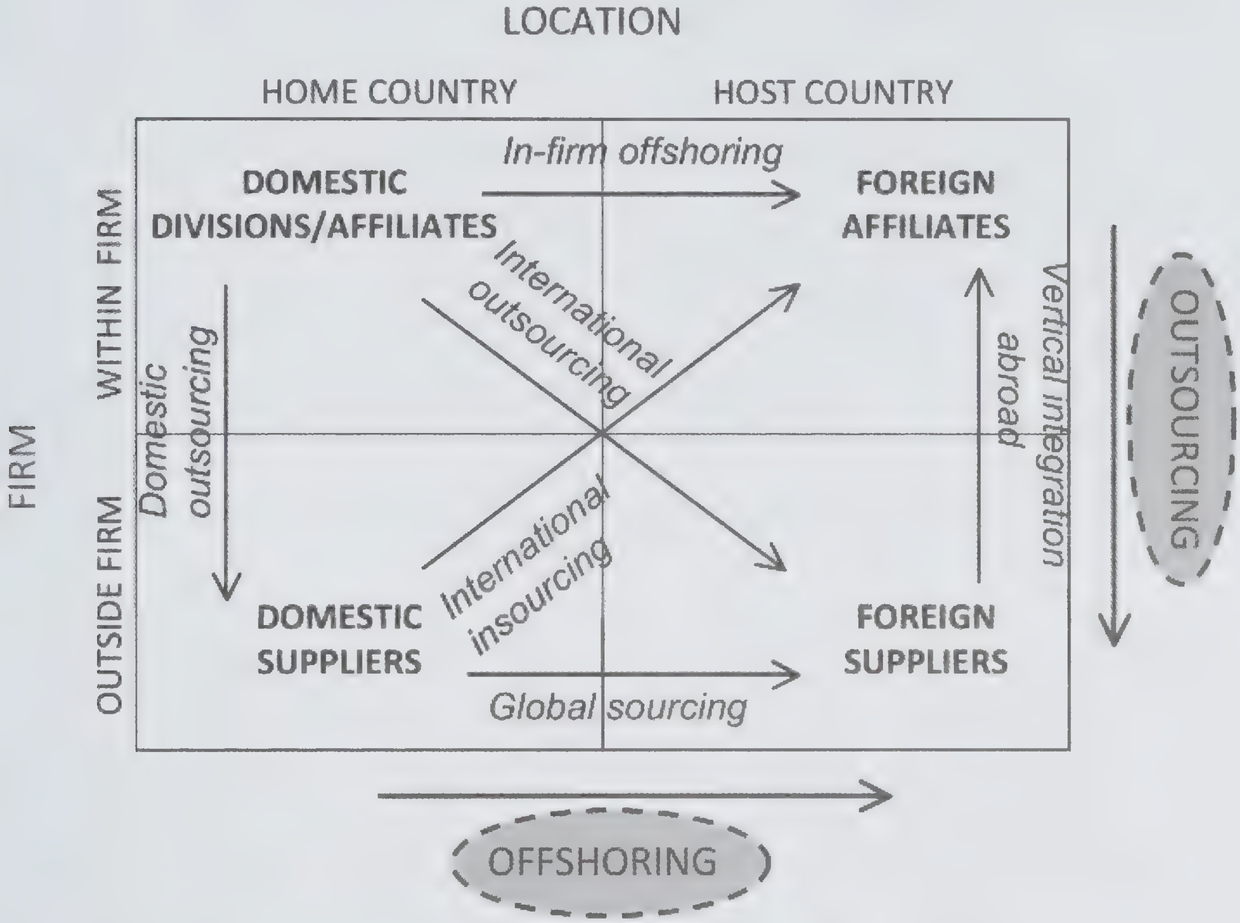
The emergence of GVCs

GVCs have been associated in the economic literature with different concepts such as 'global production sharing' (Yeats, 1997), 'international fragmentation' (Jones and Kierzkowski, 1990), 'vertical specialisation' (Hummels and Yi, 1999), 'multistage production' (Dixit and Grossman, 1982), 'sub-contracting', 'offshoring' and 'outsourcing'. The different terms all relate to the increasing importance of vertical production/trading chains across countries, although some differences exist among them. Fragmentation theory e.g. merely focuses on production activities and discusses how international fragmentation takes place if costs can be reduced due to differences in labour productivity (Ricardian model) and/or differences in factor supplies and prices (Heckscher-Ohlin model) between locations. The concept of GVCs is typically interpreted more broadly encompassing all activities of firms' value chains including production, distribution, sales and marketing, R&D, innovation, etc. Hence, motivations other than cost reductions are driving GVCs like e.g. the entry into new emerging markets and the access to strategic assets and foreign knowledge.

Firms seek to optimise their production processes by locating various production stages across different sites according to the most optimal location factors across countries. As production was earlier concentrated and integrated in one location, firms have increasingly been restructuring their operations internationally e.g. through the outsourcing and offshoring of activities (OECD, 2007). Outsourcing typically involves the purchase of intermediate goods and services from outside specialist providers, while offshoring refers to purchases by firms of intermediate goods and services from foreign providers, or to the transfer of particular tasks within the firm to a foreign location (Figure 1). Offshoring thus includes both international outsourcing (where activities are contracted out to independent third parties abroad) and international in-sourcing (to foreign affiliates).

Decisions on which activities to source outside the firm (and potentially across borders) and which ones to keep internally (but possibly in a foreign affiliate) are determined by the existence of transaction costs, the complexity of inter-firm relationships and asset-specificity. Research has for example shown that firms are more reluctant to source more complex or high-value-added activities externally, as these are often considered strategic to a firm's core business. Reversely firms often relocate high-volume production that requires low skills or standard technologies to external providers that may have cheaper or more efficient production capabilities. This would allow the firm to focus its activities on areas in which it has a comparative advantage, or allow it to engage in new, often high-value-added business activities. Evidence suggests that the organisation of international production networks differs between industries and countries.

Figure 1. Outsourcing and offshoring



Source: based on Van Welsum and Vickery (2004), Miroudot et al. (2009) and Sturgeon (2009)

Transaction costs differ between industries and thus different organisations of GVCs have emerged along industry lines. Gereffi et al. (2005) have presented a theory of GVCs, discussing different types of governance and relating these types to factors such as the complexity of transactions, the ability to codify transactions and capabilities in the supply bases. GVCs are typically organised around different players like lead firms, global suppliers, platform leaders, etc. and the roles and mandates of firms in GVCs directly depend on the types of linkages between the different actors. Dynamics in GVCs cause actors and linkages to change over time as (smaller) firms might upgrade their activities and reinforce their positions within GVCs.

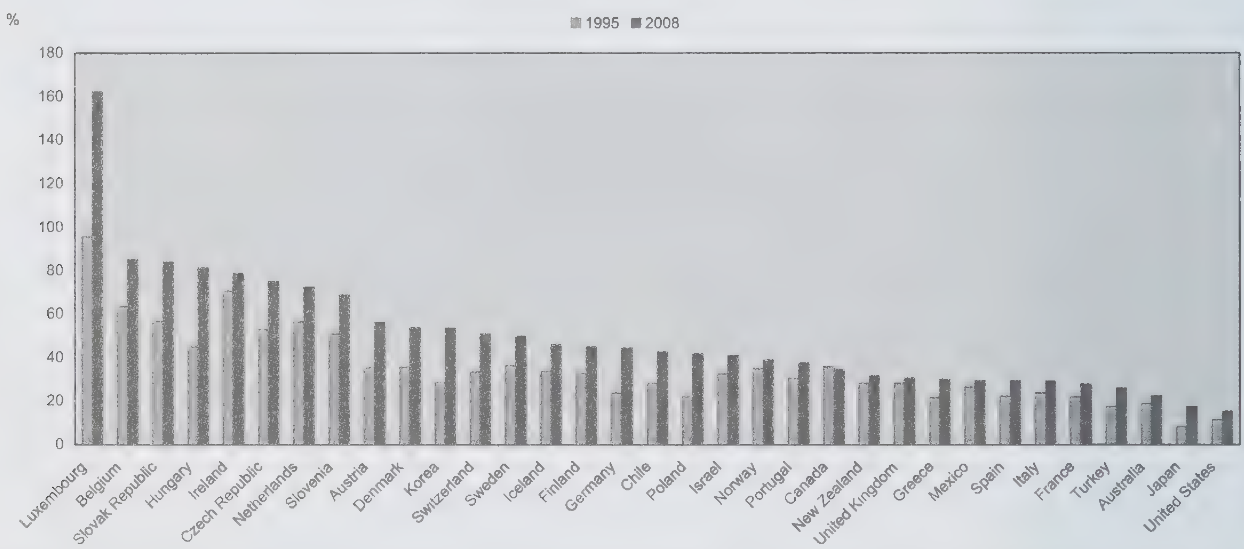
Multinational firms (MNEs) play a prominent role in global value chains because of their numerous affiliates abroad. These affiliates are not only engaged in serving local markets in the host country, but have become essential links in GVCs as they serve other (neighbouring) markets and produce inputs for other affiliates in the multinational's network. Theories of MNEs traditionally distinguish between horizontal and vertical MNEs, where the former are motivated by the desire to place production close to customers and avoid trade costs (*e.g.* tariff jumping) while at the same time realising economies of scale. Vertical MNEs have become especially important in GVCs as they undertake different stages of production in different countries; consequently, the production in one country serves as input for production activities in other countries. The cross-border trade between multinational firms and their affiliates, often referred to as intra-firm trade, accounts nowadays for a large share of international trade in goods. A

growing part of such intra-firm trade concerns the exports and imports by foreign affiliates that manufacture (part of) products destined for other markets.

Are there any stylised facts on gvcs based on trade data?

The most obvious data for comparative analysis of GVCs across countries are international trade data as they are available for a large number of countries and at a very high level of (industry/product) disaggregation. Trade data for countries indeed point to a stronger growth of trade relative to GDP, with some countries displaying trade/GDP ratio's above 100% during the last decades (Figure 2). The increasing trade/GDP ratios are assumed to follow directly from the growing importance of GVCs since intermediates are transferred several times across borders before the goods/services are sold to the final customer. As international trade data are expressed in output terms, they include the value of intermediates imported at each border crossing. In contrast, GDP is a value added concept and captures only the domestic content/value that countries are adding in the production of goods and services.

Figure 2. Trade/GDP ratio (average of imports and export in % of GDP)



Note: For technical reasons, these figures use Israel's official statistics, which include data relating to the Golan Heights, East Jerusalem and Israeli settlements in the West Bank.

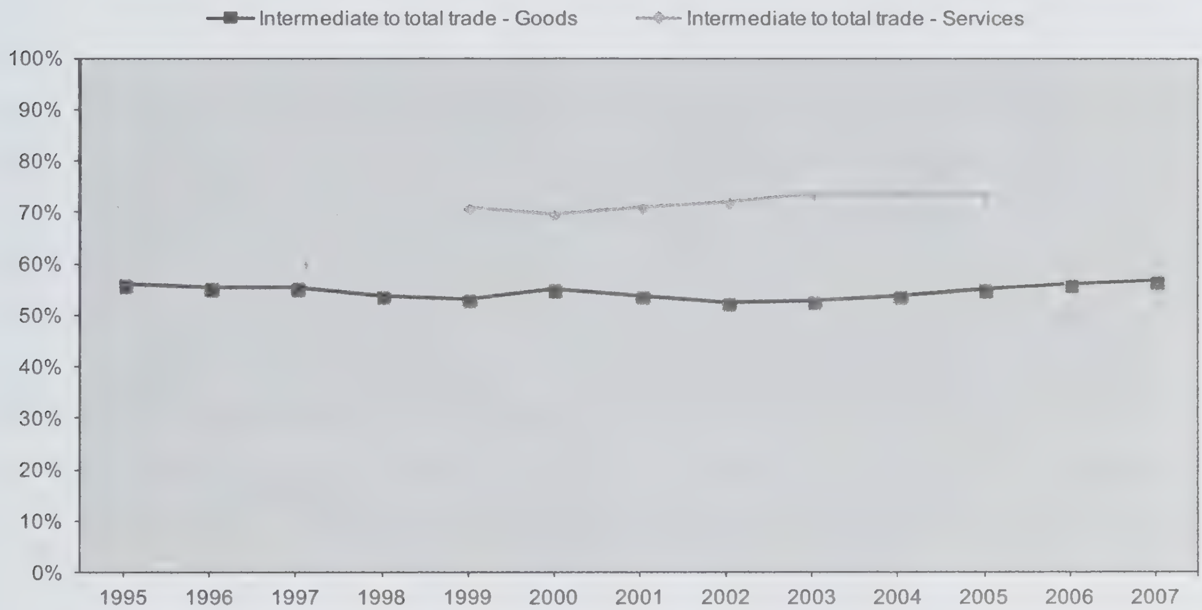
Source: OECD, Annual National Accounts.

The fact that trade data suffer from a 'double-counting' problem and tend to overstate the implicit value or factor content exchanged between countries has also contributed to a rising GDP elasticity of trade. This multiplier effect of trade relative to GDP is believed to have amplified the strong impact of the recent crisis on trade and investment. But this is not only due to the increasing spread of GVCs as also other factors help explain the dramatic drop in trade during and after the recent crisis[2].

[2] Other explanatory factors are in the first place composition effects since trade originates mainly from manufacturing while services account for the largest part of GDP. Additional factors like the collapse in internal demand and production, the fiscal stimulus plans of national governments which were more targeted at the non-tradable sector, the rise of 'murky' protectionism and the credit crunch directly aggravating problems in trade finance are also at play.

When analysing trade data in more detail, some stylised facts arise that seem at odds with (rather than supporting) the increasing importance of GVCs. A first surprising observation is that trade data do not reflect the increasing importance of intermediate trade over the last decades (Figure 2). Recent OECD work has used the United Nations' Broad Economic Classification (BEC) to identify intermediate goods and the OECD Input-Output Database to identify intermediate services[3] (Miroudot et al.,2009) . The results show that intermediate inputs indeed make up for the majority of international trade (56% of goods trade and 73% of services trade), but that this share in total trade has remained fairly table between 1995 and 2006 (Figure 3). Trade in intermediate inputs grew at an average annual rate of 6.2% for goods and 7% for services between 1995 and 2006, but trade in final goods and services grew at the same pace. Similar observations about the stable share of intermediates in total trade were also reported in Hummels et al. (1999) and Chen et al. (2005).

Figure 3. World trade of intermediate goods and services (as % of total world trade)



Source: Miroudot et al. (2009)

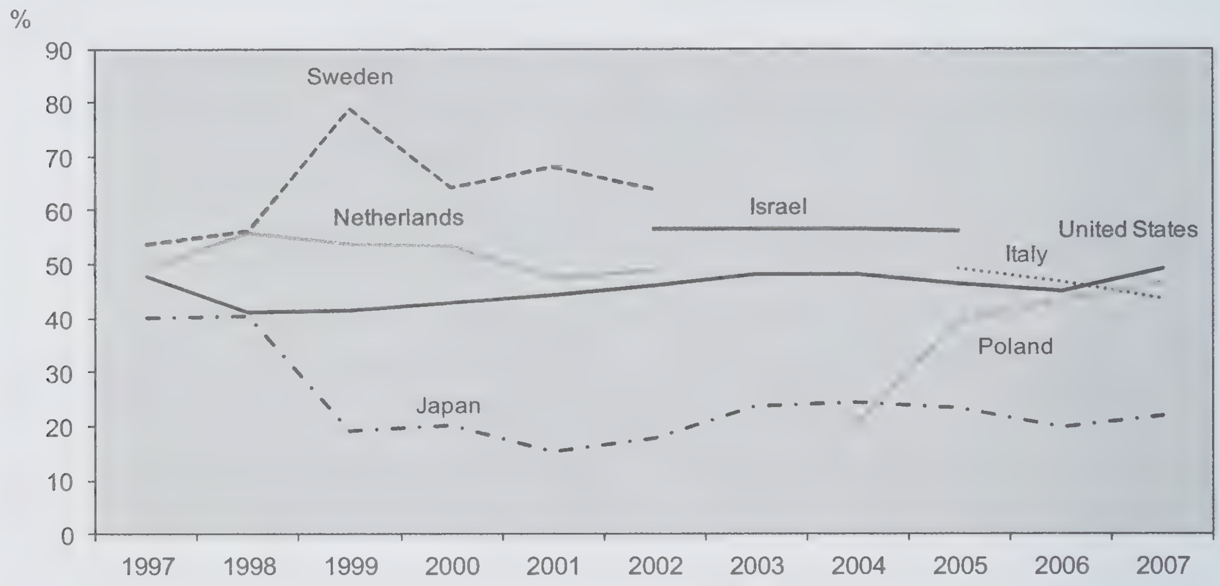
The BEC classification has recently received some criticism as it is basically the result of a (subjective) judgment based on descriptive characteristics from already some time ago and may thus not reflect any longer the actual use of goods in fast changing industries. By proposing a more updated classification of intermediates and final goods for a couple of industries, Sturgeon and Memedovic (2010) indicated that intermediates trade grew stronger (relatively to trade in final goods) particularly in the electronics and apparel and footwear industries during the last decades; in the automotive industry however, intermediates and final goods seem to show a same growth pattern.

Also data on intra-firm trade, i.e. trade between parent firms and their affiliates within MNEs do not seem to overwhelmingly support the increasing spread of GVCs. It is generally assumed that the growing importance of MNEs in GVCs results in a growing part of foreign affiliates' production being used as intermediate inputs by parent firms and

3. The BEC classification groups commodities according to their main end use into capital goods, intermediate goods and consumption goods, the three basic classes of goods in the System of National Accounts. The BEC is only available for goods but not for services trade.

other affiliates within the multinational network. But just as for trade in intermediate goods and services, the available data (only for a limited number of countries) show that though intra-firm trade is important (especially in countries like the United States, Israel, Sweden, Italy and more recently Poland), this category of trade shows a relatively stable pattern over the last decade (Figure 4).

Figure 4. Intra-firm exports in total exports of affiliates under foreign control, for selected countries (as % of total exports)



Source: OECD (2010)

Third, aggregate data on intra-industry trade, i.e. trade within the same industry[4], show an upward trend in several countries during the last decade and are as a result, very high in recent years (Figure 5). A popular assessment is that GVCs drive this evolution since industry trade data often include intermediate and final goods (e.g. motor parts and passenger cars). International fragmentation is however only one explanation for this trend, next to the increasing importance of horizontal (i.e. similar goods of different varieties) and vertical (i.e. products characterised by quality differences) product differentiation for final goods (Krugman, 1979; Lancaster, 1979; Spence, 1976; Dixit and Stiglitz, 1977; Falvey, 1981). Empirical research has largely shown that the rise in intra-industry trade is particularly due to the two-way trade of vertically differentiated products; two-way trade of

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[4] Intra-industry trade flows are conventionally defined as the two-way exchange of goods within standard industrial classifications. One measure to measure intra-industry is the Grubel-Lloyd index based on commodity group transactions. Thus, for any particular product class i, an index of the extent of intra-industry trade in the product class i between countries A and B is given by the following ratio:

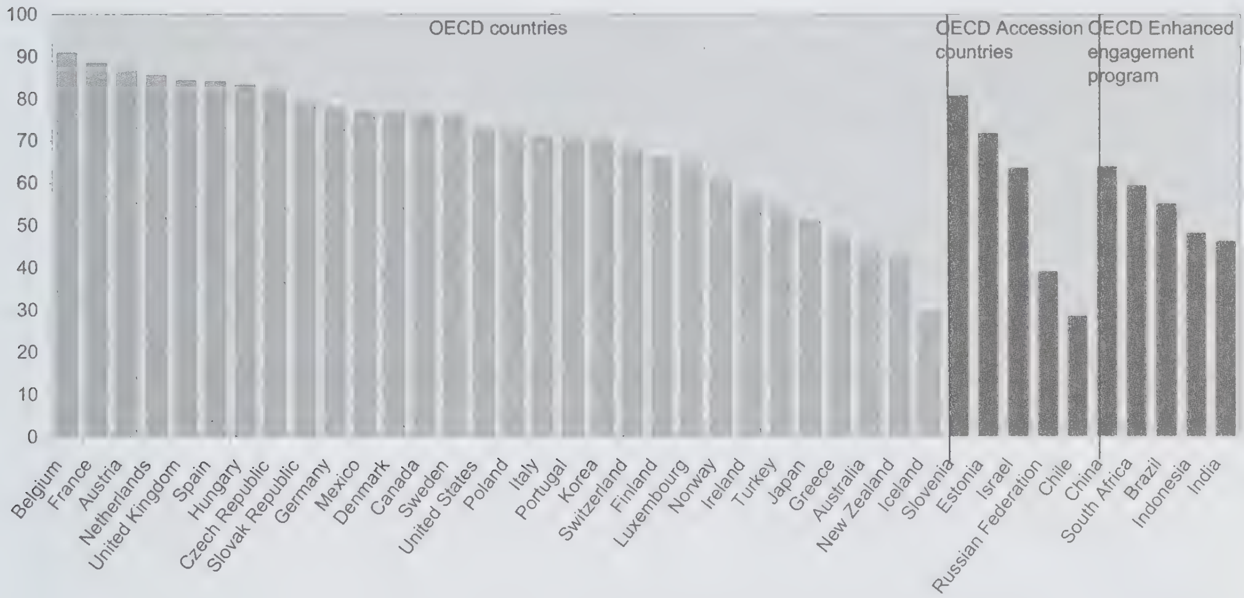
$$IIT_{i\,AB} = \left(\frac{(X_i + M_i) - |X_i - M_i|}{(X_i + M_i)} \right) \square 100$$

This index takes the minimum value of zero when there are no products in the same class that are both imported and exported, and the maximum value of 100 when all trade is intra-industry (in this case Xi is equal to Mi). A degree of caution must be used when comparing and interpreting intra-industry indices because their measurement crucially depends on the level of aggregation chosen for the analysis.

horizontally differentiated products is found to be relatively smaller (see for an overview Fontagné et al., 2006). More recently, Ando (2006), Brulhart (2008) and Turkcan (2010) argued however that part of this vertical intra-industry trade is related to back and forth trade of intermediate goods and services within GVCs.

There is a general consensus that existing trade data are not detailed enough and are not collected on the right level of analysis to analyse the international fragmentation and GVCs. Trade statistics have been designed to capture trade flows in final products while nowadays most trade is of intermediate products, hence the increasing need for measuring trade in terms of value added (Kierzkowski and Chen, 2010). Likewise, comparative advantage is typically expressed in terms of (sub-)industries according to earlier trade models, but GVCs have shifted the analysis of countries' competitiveness to activities and tasks. A clear need arises for the reassessment of the existing data and for developing new and more appropriate data and indicators.

Figure 5. Intra-industry trade (as % of total trade), average 1997-2008



Note: For technical reasons, these figures use Israel's official statistics, which include data relating to the Golan Heights, East Jerusalem and Israeli settlements in the West Bank.
Source: OECD (2010)

Input-Output data confirm the increasing importance of GVCs

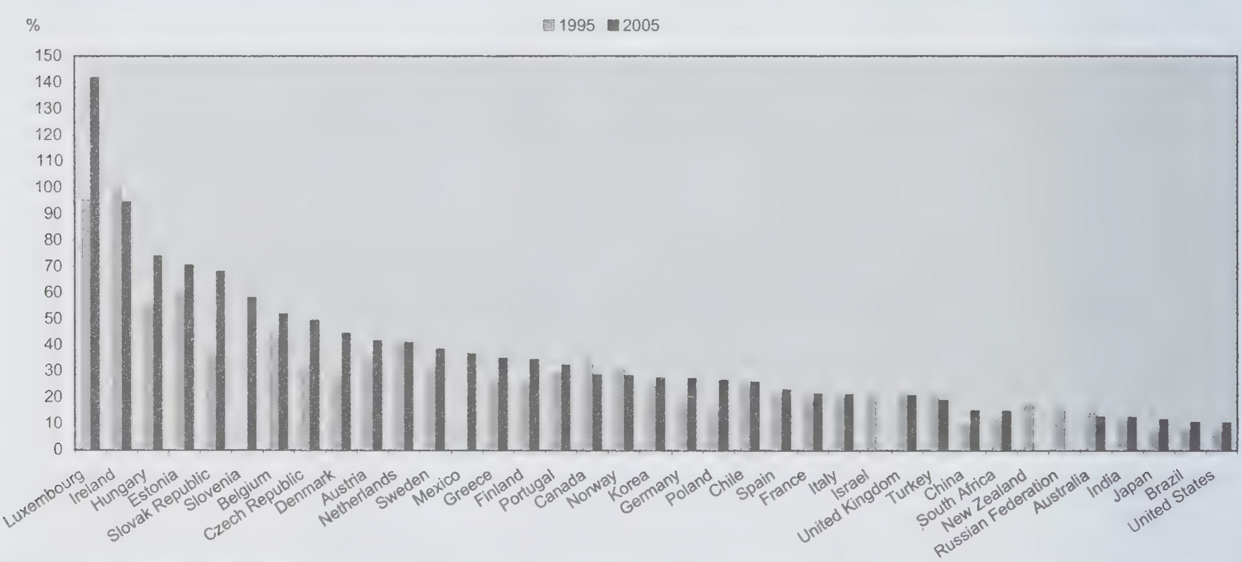
The growing importance of GVCs has increased the attention for input-output (I/O) analysis, as I/O-tables offer (complementary) information on the value of intermediate goods and services. An important advantage of I-O tables is that they classify goods according to their use (as input into another sector's production or as final demand); in contrast, classification schemes (like e.g. BEC) divide goods into intermediate and other categories based on their descriptive characteristics. In addition, I/O-tables include information on inputs of/in services sectors, allowing for the analysis of the fast growing category of services trade.

The OECD has estimated harmonised I/O-tables of different countries approximately, using a standard industry list based on ISIC Revision 3. The latest set of OECD I/O-Tables consists of matrices of inter-industrial transactions of goods and services (domestically produced and imported) in current prices for 43 countries covering

the years 1995, 2000 and 2005 or nearest years. A significant number of emerging countries are included reflecting the fact that countries like India, China, etc have become important actors in the current globalization. A number of indicators have been calculated on offhsoring and vertical specialisation which overall show, in contrast to trade data, the increasing importance of GVCs.

The OECD I/O tables distinguish between domestic intermediates and intermediates that have been imported from outside the country. The growing importance of international sourcing across industries and countries is clearly reflected in the data: the ratio of imported to domestic inputs has increased significantly between 1995 and 2005 in most countries (Figure 6). Smaller countries import relatively more intermediates from abroad which is consistent with their limited size and hence their typically larger international orientation. In Ireland e.g., domestic and international sourcing are reported to be equally important, meaning that the same amount of intermediates is sourced internationally as nationally (*i.e.* within the Irish economy). Canada is one the few countries where the ratio imported/domestic intermediates has decreased over the period considered: from 33.2% in 1995 to 29.1% in 2005. The largest decreases are observed in the industries 'electrical machinery and apparatus', 'motor vehicles' and 'other non-metallic mineral products'. Research in Canada has indicated that a rapid increase in the share of intermediate inputs in Canada materialised following the Canada – United States Free Trade Agreement and later the NAFTA agreement, but that this effect has worn off slightly in more recent years. In addition, the growing role of natural resources since about 2002 might also explain the decreasing share of imported intermediates in Canada (this might also explain the decreasing ratio for Norway and Australia).

Figure 6. Imported intermediates/domestic intermediates, by country



Note: For technical reasons, these figures use Israel's official statistics, which include data relating to the Golan Heights, East Jerusalem and Israeli settlements in the West Bank.
Source: OECD (2010)

It should be noted that most of the countries in the OECD Input-Output database applied the so-called proportionality assumption in the construction of their import matrices. Because the actual use of imported inputs is often not available, this technique assumes that an industry uses an import of a particular product in proportion to its total use of that product. Recent studies have questioned the accuracy of this assumption; Winkler and Milberg (2009) showed for Germany that the cross-sectonal variation in the

use of domestic inputs significantly differs from the cross-sectional variation in the use of imported inputs. In addition, Koopman et al. (2008) showed that the intensity of imported inputs differs between the production of processing exports and other production. This should be taken into account in the following discussion empircal indicators on offshoring and vertical specialisation.

Indicators on offshoring and outsourcing

Input-Output information allows for the construction of a number of indicators that shed some light on the (recent) trend of offshoring; the empirical measurement of offshoring (see figure 1) has proven to be difficult until now mainly because of data availability (OECD, 2007; GAO, 2004). One indicator measures companies' purchases of intermediate inputs from foreign providers, which can be independent suppliers (through transactions at arms-length) or foreign affiliates (through intra-firm trade within the multinational network) abroad. Following Feenstra and Hanson (1996, 1999), the indicator is calculated as[5]:

$$\text{OFFSH} = \sum_j \sum_i x_m^{ij} \Big/ \left(\sum_j \sum_i x_d^{ij} + \sum_j \sum_i x_m^{ij} \right)$$

where x_d^{ij} and x_m^{ij} are the domestic and imported transactions of intermediates from sector *i* to sector *j* respectively[6].

In line with the increasing importance of imported intermediates, offshoring has grown in almost all countries over the period 1995-2005 (Figure 7). Although the level of offshoring in large emerging countries such as Brazil, India, Argentina, and China remains lower than the OECD average, the data show that offshoring of intermediates has also increased in these countries. Given that this indicator is closely related to the imported/domestic intermediates ratio, the results for Canada show a negative trend between 1995 and 2005 and suggest offshoring from Canada to other countries has decreased over the period considered. Interestingly is that countries that are typically considered as important of beneficiaries of offshoring (e.g. India), also experience a increase in offshoring activities.

The calculation of the same indicator seperately for manufacturing and services directly shows why services offshoring has attracted a lot of attention recently. Different studies have discussed the growing importance of this phenomenon and have estimated the number of service jobs that have been/will be lost because of the offshoring of activities to other countries (see for an overview OECD (2007)). The I/O results clearly suggest that the emergence of global value chains increasingly stretches out to services sectors: offshoring has increased significantly over the period 1995-2005 especially in the services sector and this in almost all countries. In contrast, while the international sourcing of intermediates is on average more important in manufacturing[7], it has increased relatively little over the period 1995-2005 in most countries except for Eastern European countries.

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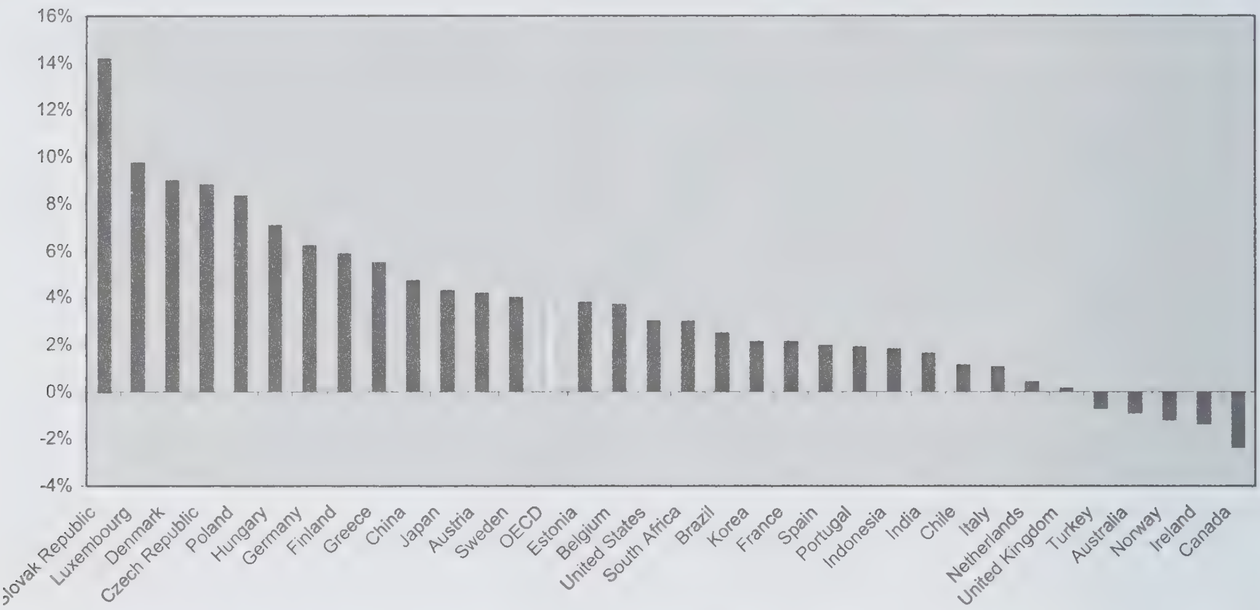
5 Feenstra and Hanson (1996, 1999) have used this indicator as proxy for outsourcing, but following the definitions of outsourcing and offshoring discussed above, the indicator should be interpreted as a measure of offshoring.

6 Other indicators on offshoring have been presented; see for an overview De Backer and Yamano (2007).

7 The sourcing of intermediates abroad appears to be relatively more important in higher technology industries than in lower technology industries, reflecting the in general higher complexity of technology intensive goods as they typically require a broad range.

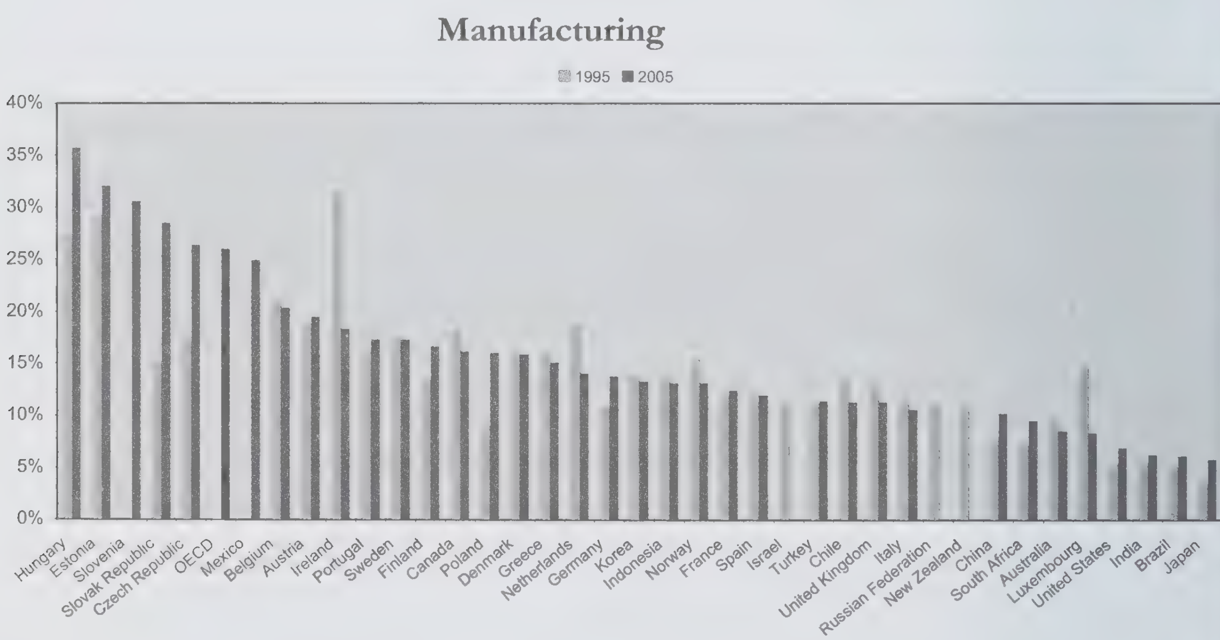
Following their adhesion to the European Union, these countries have attracted a large number of (Western European) multinational companies and as a result of the international sourcing strategies of these companies, manufacturing offshoring in these countries has strongly grown (Figure 8).

Figure 7. Growth in offshoring, by country, 1995-2005



Note: For technical reasons, these figures use Israel's official statistics, which include data relating to the Golan Heights, East Jerusalem and Israeli settlements in the West Bank.
Source: OECD (2010)

Figure 8. Offshoring in manufacturing and services, by country



Note: For technical reasons, these figures use Israel's official statistics, which include data relating to the Golan Heights, East Jerusalem and Israeli settlements in the West Bank.
Source: OECD (2010)

Indicators on vertical specialisation

As the share of intermediates trade in total trade showed a relative stable pattern during the last decades, some authors have argued that the increasing importance of GVCs is particularly demonstrated by a subcategory of intermediates, more specifically those that are imported and used to produce goods that are exported (Chen et al., 2005). The emergence of GVCs makes that imports and exports increasingly move together because of the sequential production process and back-and-forth trade between countries. I/O tables measure the interrelationships between the producers of goods and services (including imports) within an economy and the users of the same goods and services (including exports). As such they can be used to estimate the contribution that imports make in the production of any good and service for export.

By introducing the term 'vertical specialisation'[8], Hummels et al. (2001) calculated the direct and indirect imported inputs that are included in a country's exports. For example, if a motor car manufacturer imports certain components (e.g. the chassis) the direct import contribution will be the ratio of the value of the chassis to the total value of the car. And if the car manufacturer purchases other components from domestic manufacturers, who in turn use imports in their production process, those imports must be included in the car's value. Hence, these indirect imports should be included in the overall contribution of imports to the production of motor cars for export.

A first indicator of vertical specialisation ($VS1_i$) is calculated as the import content embodied in country i's exports:

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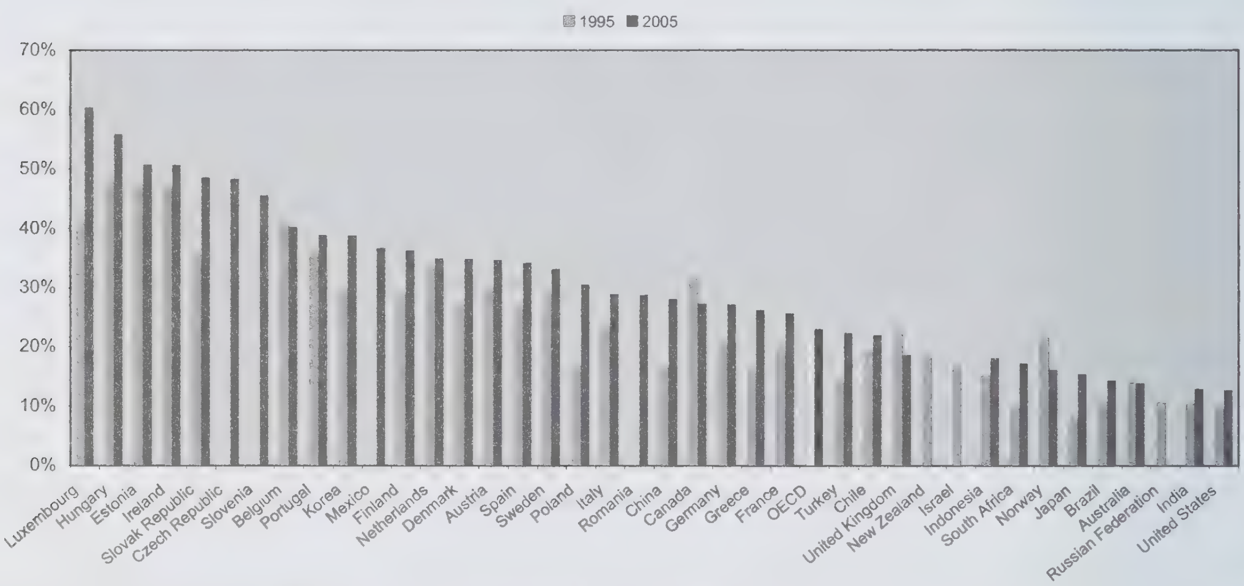
[8] As a result of GVCs and the corresponding geographical fragmentation of activities, countries become vertically specialised within the production process for some good or services as companies tend to concentrate different production stages for a single good in each country. The vertical specialization measures try to reflect this process by which different countries become part of a single production chain, linking the imported inputs required by one country with its exports.

$$VS1_i = u * Am_i * [I-Ad_i]^{(-1)} * X_i/\sum X_i$$

where Am_i and Ad_i contain the input-output coefficients of country i for imported and domestic transactions respectively; u denotes an 1 x n vector each of whose components is unity, the matrix X_i is an nx1 vector of exports of country i and $\sum X_i$ is total country i's exports. This vertical trade is made up of intra-firm trade within multinational companies at the one side and vertical trade at arm's length relationships between independent companies at the other side.

The results clearly show that countries' exports are increasingly composed of intermediate inputs that are imported from abroad; between 1995 and 2005, the import dependency of exports increased in almost all countries (Figure 9). This increase was particularly strong in Luxembourg, Poland, the Slovak Republic, China and Greece. In contrast, the import content of Canadian exports decreased between 1995 and 2005 from 30% to 24%.

Figure 9. Vertical specialisation VS1 (import content of exports), by country



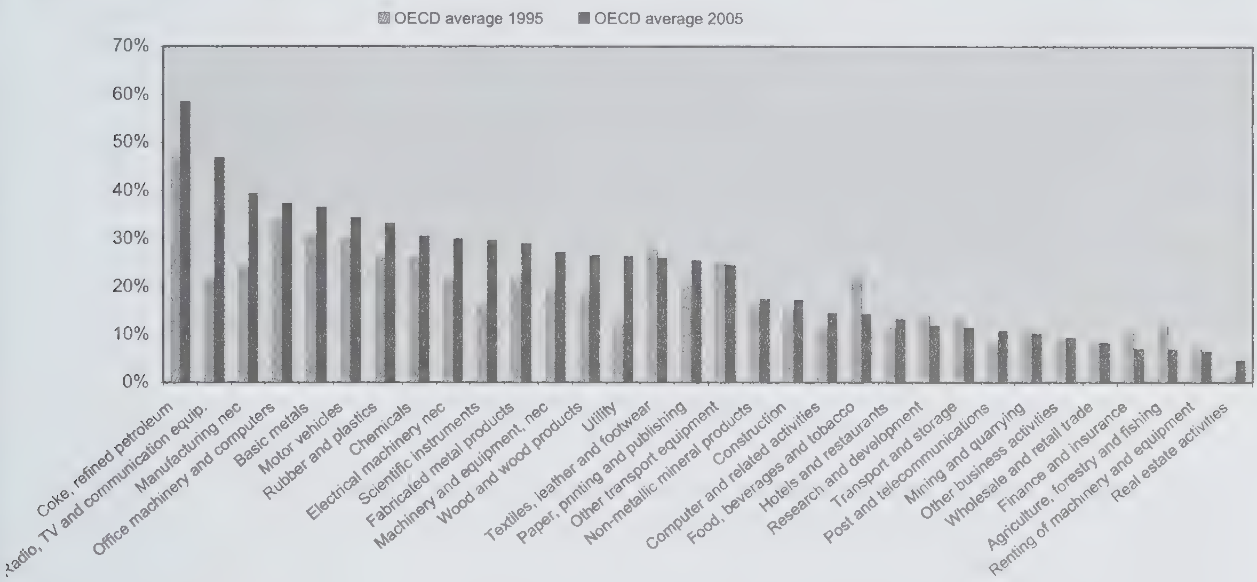
Note: For technical reasons, these figures use Israel's official statistics, which include data relating to the Golan Heights, East Jerusalem and Israeli settlements in the West Bank.
Source: OECD (2010)

The import content of exports represented in 2005 on average 23% of total trade among OECD countries; in some countries such as Luxembourg, Hungary, Ireland and Estonia, the import content of exports exceeded 50% in 2005. Other countries like the United States, Russian Federation, Australia, Brazil and India import relatively less vertical trade than other countries because of their size. These typically smaller values of vertical specialisation for larger countries reflect that more links in the GVC are located within the (large) country.

Vertical specialisation takes place both within MNEs and through offshoring to external suppliers. The results for the VS1 measure suggest that the import content of exports is closely related to the presence of MNEs. The increase in vertical specialisation comes most clear in countries with a high multinational presence. Foreign affiliates in different host countries produce intermediates that are then exported to final consumers, but also to other affiliates and to the headquarters of the multinational company.

The degree of vertical specialisation is found to be particularly large in more basic industries that are heavily using primary goods like cokes and refined petroleum, basic metals, chemicals, and rubber and plastics. A second group of industries concern higher technology intensive industries that produce modular products. Parts and components are often produced in one country before they are exported to another country where the assembly is taking place. This international division of labour is found in industries like electrical machinery, radio/television and communication equipment, office, accounting and computing machinery but also motor vehicles (Figure 10).

Figure 10. Vertical specialisation VS1 (import content of exports), by industry



Source: OECD (2010)

The indicator of vertical specialisation can be calculated for intermediate and final goods separately in order to analyse in more detail the specific position of countries in the vertical production process. The vertical specialisation for intermediates ($VS1^{intermediates}$) reflects especially the importance of imported intermediates for the production and exports of parts and components; hence this measure indicates the position of countries in the production of intermediates. Vertical specialisation for final products ($VS1^{final}$) represents the imported intermediates usage in the exports of final products and gives merely an idea about the position of countries in the final assembly process. This position of countries in GVCs is assumed to be directly related to the technological profile of countries (Uchida and Inomata, 2009): the production of parts and components for consumer goods especially in high technology intensive industries, requires on average larger technological capabilities and more advanced business processes, hence these activities will be relatively more undertaken in technology advanced countries. The assembly of parts and components into final products, even in higher technology industries, is rather based on simple routines and hence less technological advanced countries will 'specialise' in these activities.

The results for $VS1^{intermediates}$ and $VS1^{final}$ confirm this general picture (Figure 11): while countries like Hungary, Indonesia, Estonia, the Czech Republic and the Slovak Republic show a strong integration in both intermediates and final goods, they show relatively higher $VS1^{final}$ than $VS1^{intermediates}$ measures (Figure 10). In contrast, countries like Japan, United Kingdom and the Netherlands seem to specialise more in the production of

(high value added) intermediates as they show rather higher $VS1^{intermediates}$ measures (relative to $VS1^{final}$).

Comparing the results for 1995 and 2005 reveals some interesting changes in the position of countries in GVCs: China e.g. showed in 1995 relatively higher VS1 measures for final goods indicating the strong assembly activities in the mid '90s. This $VS1^{final}$ measure has further increased over the period 1995-2005 showing the increasing importance of downstream assembly activities in China. However, at the same time, China seemed to have also moved into the more upstream production of parts of components (for the production of other intermediates), which is most likely related to the technological upgrading of the country over the years. Other studies have also suggested that some assembly activities are increasingly moved away from China to other Asian countries like Vietnam, Cambodia and the Philippines.

Canada showed a relatively higher vertical specialisation in final goods and services in 1995, indicating a relatively stronger commitment of Canada in final assembly activities. But this position has weakened over the period 1995-2005, as especially the vertical specialisation in final products is the major explanation of decrease in total vertical specialisation for Canada. The import content of Canadian exports of intermediate goods/services has stayed relatively stable over the period considered, suggesting that the position of Canada has somewhat changed in GVCs, from downstream assembly activities of final products to more upstream production activities of intermediate products.

The measures of vertical specialisation discussed until now look at vertical specialisation merely from the viewpoint of an exporting country demanding intermediates from abroad ('how many exports are directly and indirectly needed for the production of exports'). An alternative measure computes vertical specialisation rather from an exporting country supplying intermediate inputs abroad. This second measure, proposed by Yi (2003), indicates how much of a country's exports are used as intermediate inputs in the exports of other countries and is especially important for countries specialising in the first stages of the vertical chain[9]:

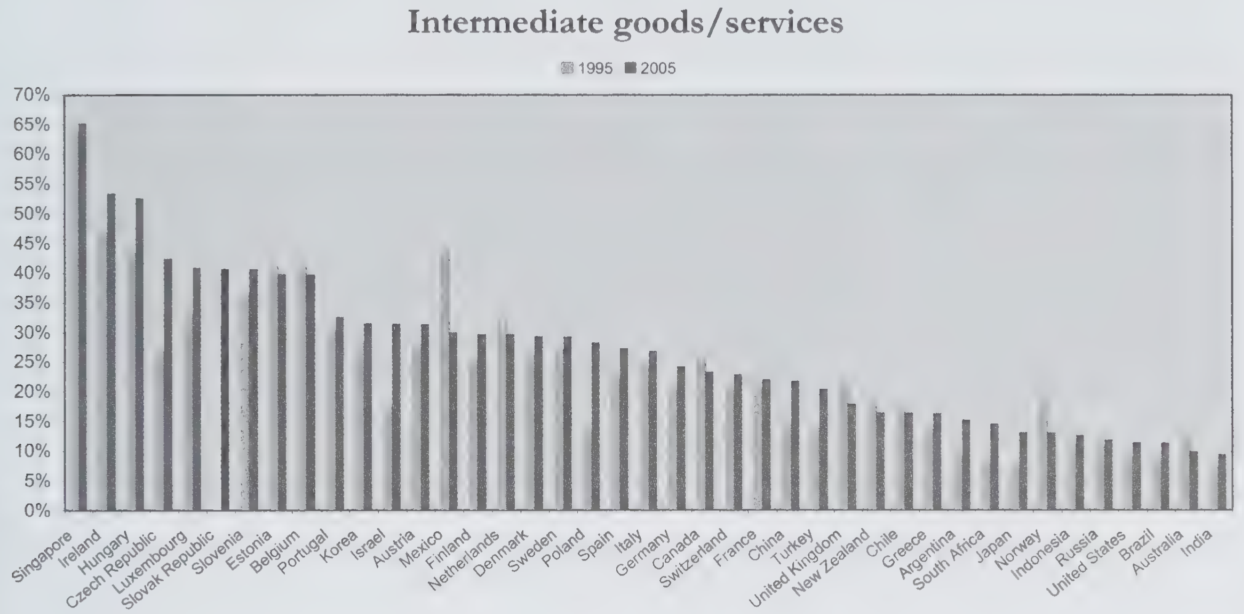
$$VS2_i = \sum(n)\ [Am_n(i)\ [I-Ad_n]^{(-1)} * X_i(n)] / \sum(n)\ X_i(n)$$

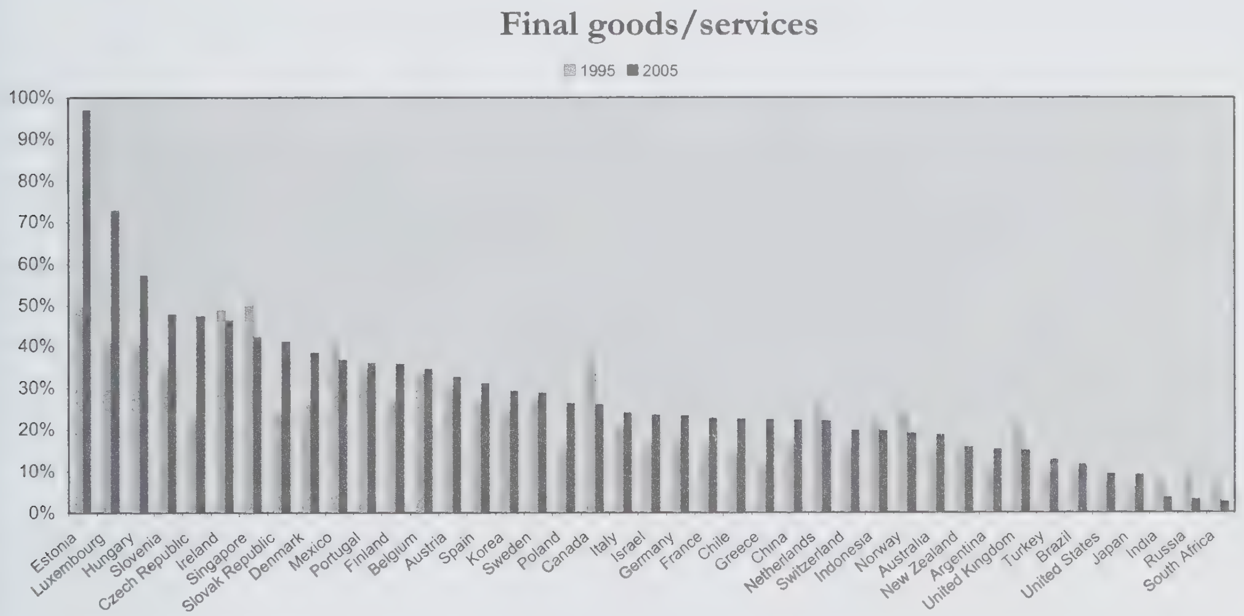
where $Am_n(i)$ is the input coefficient matrix of country n for imported transactions from country i , Ad_n contains input-output coefficients for domestic transactions in country n, the matrix $X_i(n)$ contains exports from country i to country n, $\sum(n)\ X_i(n)$ are the total exports of country *i*.

This second indicator of vertical specialisation also shows a clear upward trend between 1995 and 2005 in most of the countries, further confirming the increasing importance of global value chains and the accompanied rise in vertical trade and trade of intermediates (Figure 12). Countries like Australia and Norway because of their natural resources and Japan and the United Kingdom because of their specialisation in the production of parts and components show significantly higher values on this second indicator of vertical specialisation (relative to the VS1 measure). In contrast, countries that are more specialised in final assembly activities show relatively lower values on this second indicator. Canada shows relatively lower indicators for this second indicator (suggesting that Canada's position in GVCs stems rather from the import demand for intermediates inputs than the production of intermediates for other countries), but this indicator has showed a much more stable pattern over the period 1995-2005.

[9] One of the advantages of this measure is that it less dependent on country size.

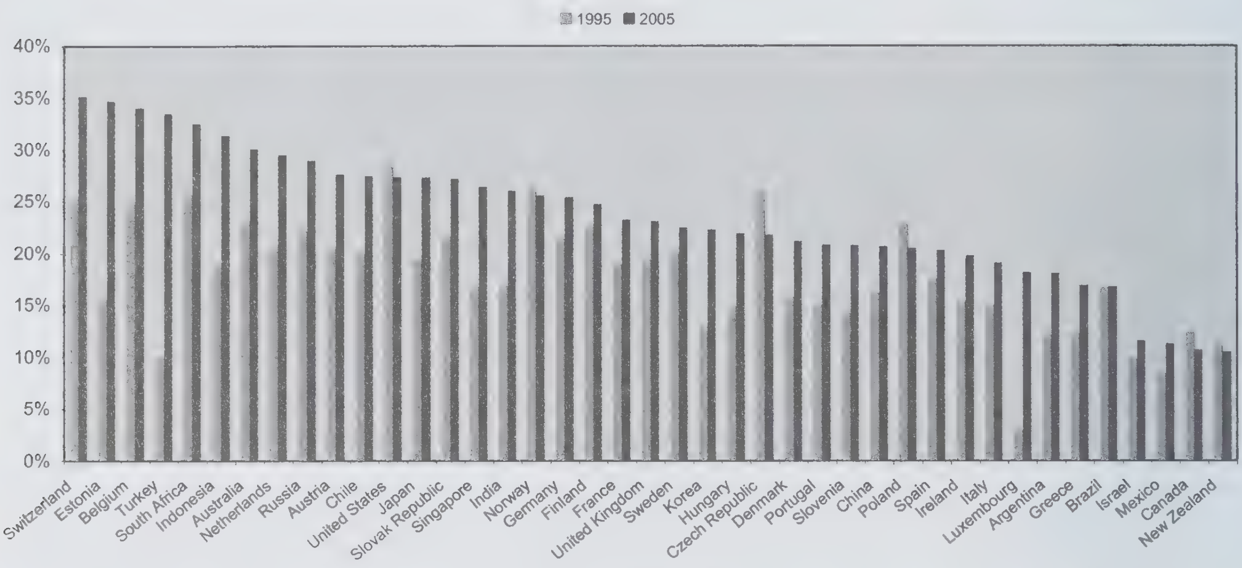
Figure 11. Vertical specialisation VS1 (import content of exports), intermediate and final goods/services





Note: For technical reasons, these figures use Israel's official statistics, which include data relating to the Golan Heights, East Jerusalem and Israeli settlements in the West Bank.
Source: Calculations based on OECD I/O tables

Figure 12. Vertical specialisation VS2, alternative measure



Note: For technical reasons, these figures use Israel's official statistics, which include data relating to the Golan Heights, East Jerusalem and Israeli settlements in the West Bank.
Source: Calculations based on OECD I/O tables

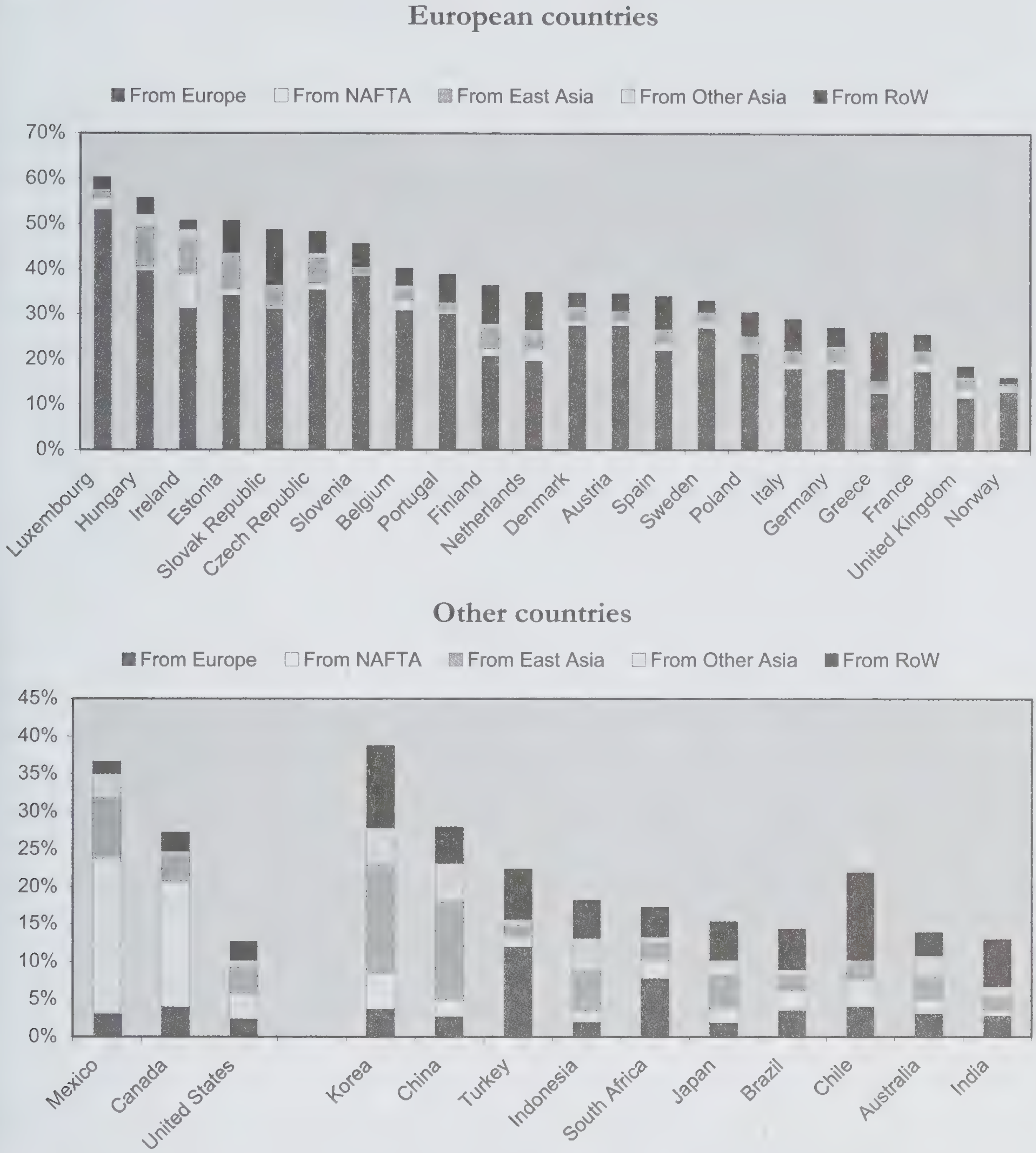
Together the two indicators show the integration of countries in the growing spread of GVCs, both as a producer of intermediates to be included in other countries' exports and as a demander of intermediates to include in own exports. The strong increase in both VS measures for China e.g. over the period 1995-2005 demonstrates in the first place that China has become more central in international production networks, both as an assembler of final products and producer of intermediates. Second, the large vertical specialisation of China (especially the still large (downstream) assembly activities) indicates that the competitiveness of China is largely built on the intermediates produced somewhere else. The position of Canada in GVCs at the world level has become less important, especially in final assembly activities. This seems to be related to changes in industrial structure in a number of industries like 'electrical machinery and apparatus' and 'motor vehicles'.

Economic linkages between countries: linking IO data with trade data

By linking I/O tables with bilateral trade data, more insights on the origin and destination of imported intermediates can be gained and the specific linkages between individual countries can be assessed. The distribution of the vertical specialisation measure VS1 by partner countries/zones suggests a strong 'regional' character of GVCs (Figure 13). Countries source intermediates and incorporate them in their exports to a larger degree from neighbouring countries which is likely related to the importance of distance and trade costs for vertical trade.

The import content of exports of European countries is heavily based on other European countries. In most countries around three quarters of the intermediates embodied in exports are sourced from around Europe. Only Ireland seems to be a bit different with a relatively large sourcing from NAFTA countries; the large presence of especially US multinational companies is likely to explain this observation.

Figure 13. Vertical specialisation (import content of exports) VS1 with partner countries



Source: OECD (2010)

Within the NAFTA region, Canada and Mexico are heavily oriented towards the other NAFTA countries: more than 50% of the imported intermediates embodied in their exports originate in the NAFTA zone. The situation is a bit different for the United States, with a lesser importance of the two other NAFTA countries and a larger share for East Asian countries.

In Asian countries like Japan, China and Korea, the majority of the intermediates embodied in their exports are sourced from within the region. Previous research has shown that a triangular trade pattern has emerged in this region, in which parts and components are produced by more developed countries like Japan, and Korea and then exported to emerging countries like e.g. China and recently increasingly also to other

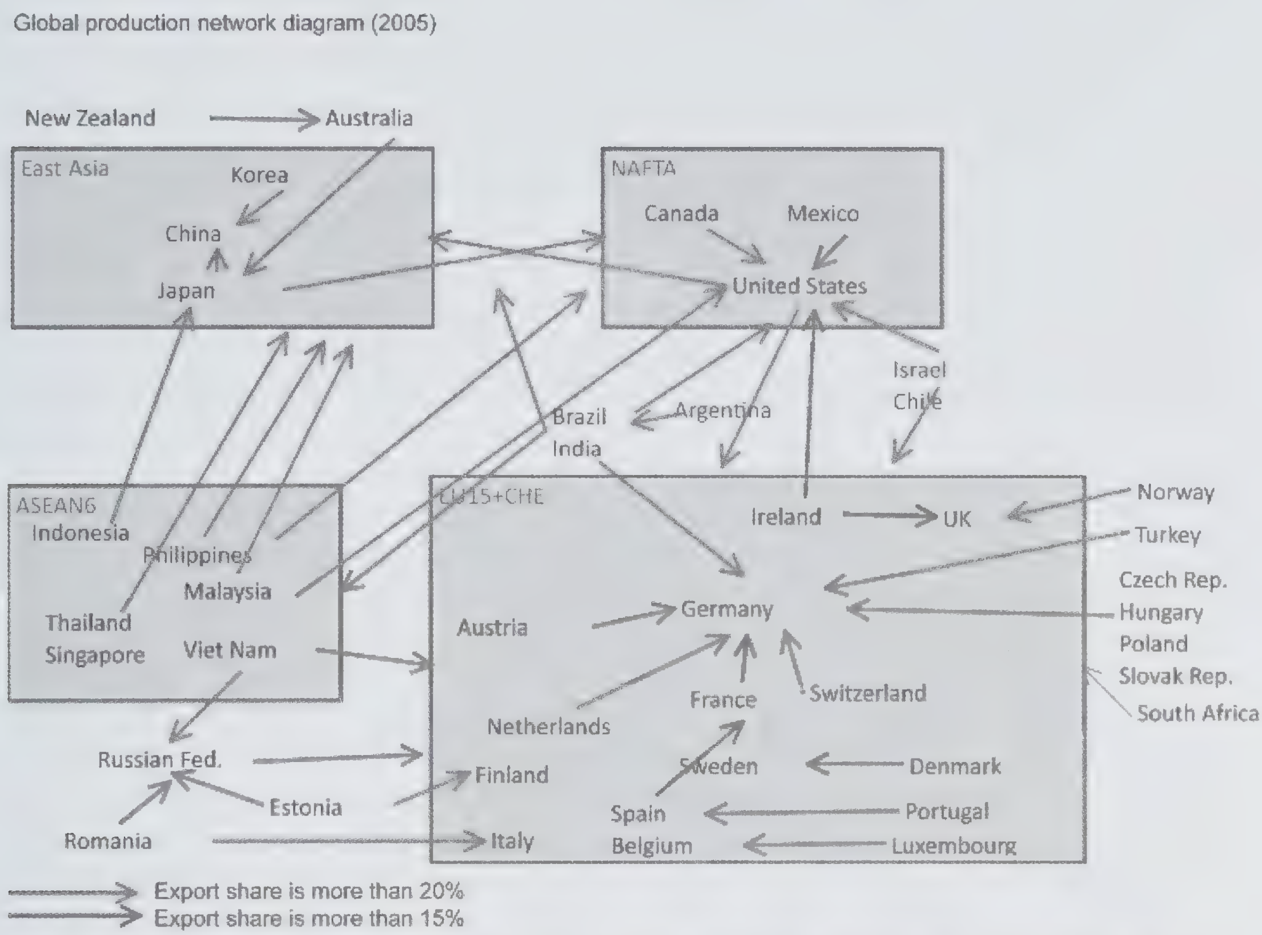
countries like Vietnam, Cambodia and the Philippines where the assembly of the different intermediates into finished products is takes place. The assembled final products and intermediates are then exported back to Japan, Korea, etc. as firms re-import a growing part of the production they relocate. Assembled products from China are also exported to other developed countries/regions such as Europe and the United States where they may undergo in addition some smaller changes (packaging, marketing, etc.) and hence appear in the vertical trade of these countries. The case of Apple's iPod illustrates this clearly: components for this product are produced in Japan, Korea and the United States, are then assembled in China and then exported to the United States (Linden et al., 2009).

The regional character of GVCs is also clearly illustrated when identifying so-called 'dominant' links of intermediate trade flows between economies. Figure 14 presents the (bilateral) exports of intermediates which represent more than 15% and 20% of the total exports of the (exporting) country. The results suggest the existence of 3 large groups of economies in the global trade of intermediate products: NAFTA, EU and Asia including East Asia (with Japan, Korea and China) and ASEAN economies. A large number of dominant links are identified within these groups of economies, while export flows between individual economies across different regional groups are significantly less important. It is merely by aggregating exports of different economies within regional groupings that dominants between NAFTA, EU, East Asia and ASEAN appear.

There are some exceptions like e.g. the exports from Ireland to the United States which is most likely to be related to the large presence of US MNEs in Ireland. A stronger integration is also observed within Asia between East Asian and ASEAN economies and of Asia with other regional blocs. Yamano et al. (2010) showed how the production networks between Asian economies has become much more integrated over the period 1995-2005 and how intermediates are largely exchanged between economies.

In accordance with the results reported above, Canada seems especially to be integrated in the NAFTA bloc with more than 20% of Canadian exports of intermediates going to the United States. Canada shows no dominant links with Mexico (the other country in the NAFTA regional group) or other economies in the world. The United States is still the central node in the NAFTA grouping, being an important demand centre for the intermediates produced and exported by Canada and Mexico.

Figure 14. Dominant links between economies, exports of intermediates, 2005



Source: Own calculations based on OECD Input-Output Database (September, 2010) and OECD STAN BTD (March, 2010)

The United States has become however less central, as Annex 1 shows a similar graph of dominant links in intermediates exports for the year 1995. The graph clearly shows how GVCs have significantly changed over a period of 10 years: while in 1995 Japan, Germany and the United States were by far the most important production centres, the increasing spread of GVCs across a larger number of economies shows the stronger integration and hence larger economic dependency of economies.

Conclusion: the need for better policy evidence

Policy makers show an increasing interest in GVCs because of the pervasive effects GVCs have on national economies and are especially looking for more and better policy evidence. As GVCs extend from production over logistics and marketing to R&D and innovation activities, several policy domains (trade, competitiveness, industrial policy, R&D and innovation, etc.) will be influenced by the new international organisation of productive activities. Globalisation in general and GVCs in particular are expected to result in a more efficient allocation of productive resources across the world.

The review of the available data and indicators on GVCs in this paper overall shows the increasing importance of GVCs in today's global economy, but at the same time clearly highlights some major shortcomings. While the empirical evidence based on trade data is less convincing, Input-Output data clearly reveal the growing spread of international production networks. Indicators on imported intermediates, offshoring and vertical

specialisation all illustrate the growing fragmentation of production across more economies. Trade data seem to show the increasing importance of GVCs only in an indirect way but the existing trade data are not detailed enough and are not collected on the right level of analysis to analyse the international fragmentation and GVCs.

Further on, while descriptive in character, the existing data and indicators fall short of capturing the impact of GVCs on the competitiveness of countries. New and more intense competition directly affects the international competitiveness of countries and forces governments to analyse carefully in which activities and industries they can keep/gain their comparative advantage. The growing flows of intermediate inputs have increased the economic interdependency between economies but have also contributed to changing patterns of international competitiveness of countries. The international fragmentation allows/forces countries to specialize in different activities in the production process (production of intermediates, final assembly, etc.), in addition to their traditional specialization in products and industries.

The international performance of countries is often compared using export market shares and indicators of revealed comparative advantage (see *e.g.* The European Competitiveness Report, 2008)[10]. GVCs directly challenge these 'export' measures of competitiveness as countries' exports are increasingly made up of imports of intermediates inputs from abroad and indicators based solely on export data of final goods might misrepresent the real specialisation of countries. A favourable export-based indicator does not necessarily indicate a competitive edge in the production of a specific good and might hide the fact that a country is merely specialised in the final assembly of that good by importing intermediate inputs while adding/creating less or no value to the good itself.

Koopman et al. (2008) showed that the share of foreign value added in Chinese manufactured exports is about 50%. Looking specifically at processing exports which benefit from duty exemptions on imported raw material and other inputs 'as long they are used solely for export purposes', this foreign share rises up to 82%. As a direct corollary of this, GVCs might also qualify the large trade (bilateral) imbalances between countries. For example, Kierzkowski and Chen (2010) have shown that taking into account the imports of parts and components by both countries reduced the large US deficit with China by approximately half, given that a lot of high value intermediates are exported from the United States to China.

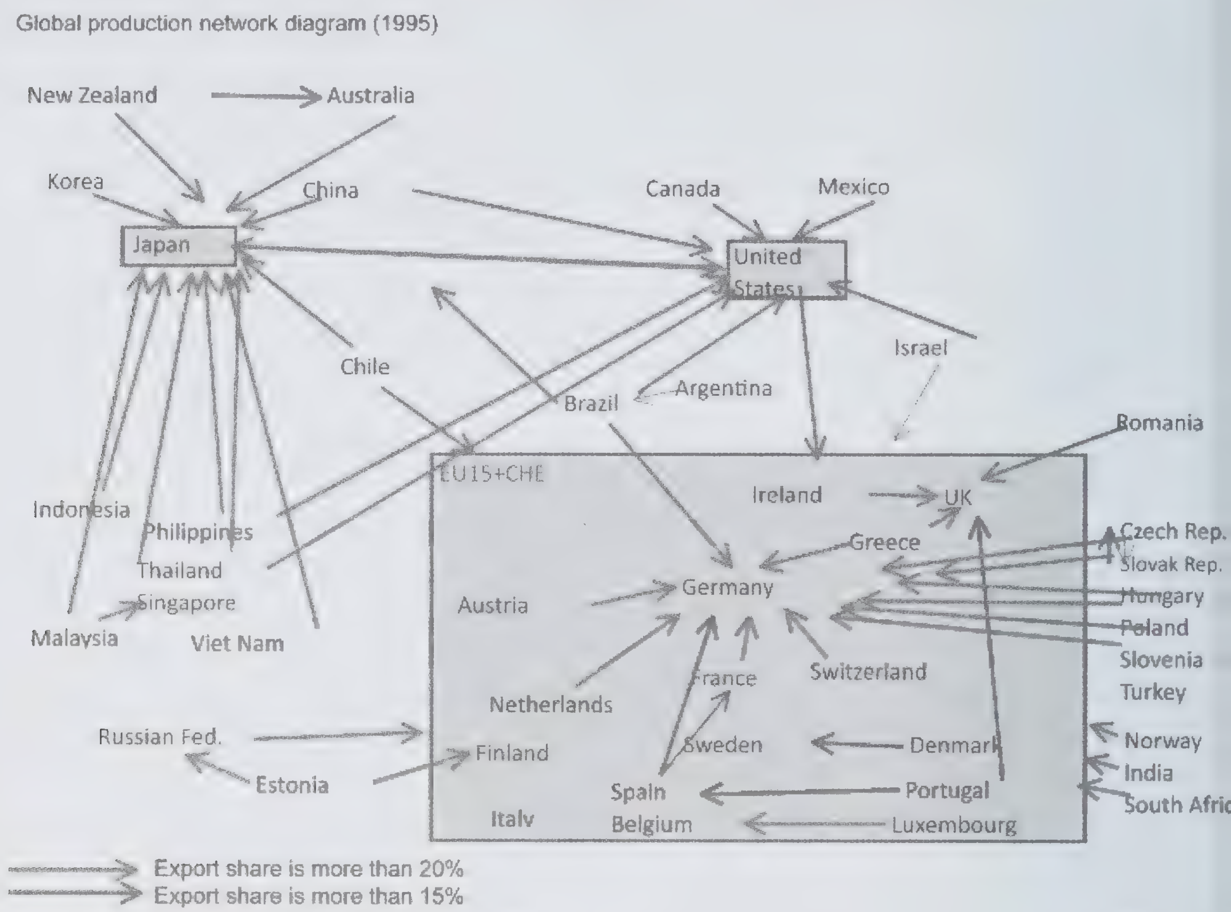
A micro-economic analysis of the international value chain of the iPod has clearly demonstrated the discrepancy between trade performance and value creation across countries (Linden et al., 2009). Using firm-level information, the analysis showed that China was merely specialized in the assembly of the imported intermediates into the final product which is typically generating relatively little value. The largest part of the value creation throughout the production process was done and captured by the producers of high value components (United States and Japan) and the seller of the iPod (Apple in the United States). The iPod example shows that the concept of competitiveness may sometimes need to be assessed at a detailed level, in order to fully understand what drives the international performance of countries.

The OECD is developing new empirical evidence studying the emergence of GVCs based on international trade data and Input-Output data. In addition, the OECD is currently cooperating with other international agencies and academic experts to develop

[10] Empirical measures of comparative advantage go back to the seminal work of Balassa (1965): comparative advantage is expected to determine the structure of exports, hence the construction of export performance indices to 'reveal' the comparative advantage of countries.

new metrics for GVCs, for example data on trade in value added. One of the main shortcomings of international trade data is that they are expressed in output terms and hence include the value of intermediates imported at each border crossing As such, international trade data suffer from a 'double-counting' problem and tend to overstate the implicit value or factor content exchanged between countries. Trade in value added aim to capture only the domestic content/value that countries are adding to goods and services and will give a better picture of the integration of countries in GVCs.

Annex 1
Dominant links between economies, exports of intermediates, 1995



Source: Own calculations based on OECD Input-Output Database (September, 2010) and OECD STAN BTD (March, 2010)

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China's Role in Global Production Networks

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Introduction

Vertical specialization is one of the most notable trends in the international organization of production (Hummels, Jun and Yi, 2001; Yi, 2003; Desai, 2009). Thanks to reductions in communication, transportation and other trade costs, multinational firms are slicing up their value chains and are dispersing their production activities across multiple countries. This means that a single final good is often worked on in many countries, with each sequential node in the value chain performed in the location that is most advantageous for the process.

China has been a large beneficiary of this vertical specialization process, with multinational firms integrating the country into their global production networks by offshoring labor-intensive final assembly activities to the country (Branstetter and Lardy, 2006; Amiti and Freund, 2008). However, at least a few questions about China's role in these global production networks are left unanswered. First, in which type of industries is China integrated into global production networks? The answer to this question will be important to understand the driving forces behind the rapid technological upgrading trajectory of China's exports. Second, what factors have driven multinational firms to offshore assembly activities to China? Existing studies generally attribute this to the country's relatively low labor costs and its favorable export promotion policies. But, as we will discuss below, China's heavy reliance on imported inputs for its assembly activities suggests that its geographic location may also have played an important role. Finally, how important is Canada as a supplier to these global production networks?

To address these questions, this paper will exploit a unique data set collected by the General Administration of Customs of the People's Republic of China (in short, *China's Customs Statistics*) that disaggregates China's international trade by customs regime. The data set highlights the large and rising importance of China's processing trade regime throughout the reform period. In the mid-eighties, the Chinese government put this customs regime into place to entice foreign firms to offshore their production activities to China. Under this regime, firms located in China are granted duty exemptions on imported raw materials and other inputs *as long as they are used solely for export purposes.* Since its installment, processing exports has rapidly expanded to more than half of China's overall exports. By the very nature of the processing trade regime, processing trade transactions are conducted by firms that use China as an export-assembly platform of imported inputs. The processing trade data therefore provide a direct measure of imported input flows and exported output flows associated with global production networks in China for the years 1992-2007. This allows us to gain new insights into the structure of global production networks that set up processing activities in China, the role that China plays therein, and the link between Canada and China in these networks.

This paper consists of four Sections. Section 2 will conduct an anatomy of China's processing trade to analyze the type of production networks that use China as a processing location and the role that China plays therein. Furthermore, we will investigate the link between Canada and China within these production networks. In Section 3, we will use insights into China's role in global production networks to reassess China's growing role in world trade. We will demonstrate that it puts into question the empirical evidence that China is rapidly moving up the technological ladder. Furthermore, we will show that it has allowed China to pass on a significant portion of its negative exports demand shock that it faced during the recent economic crisis to its East Asian neighbors. Finally, Section 4 provides concluding remarks.

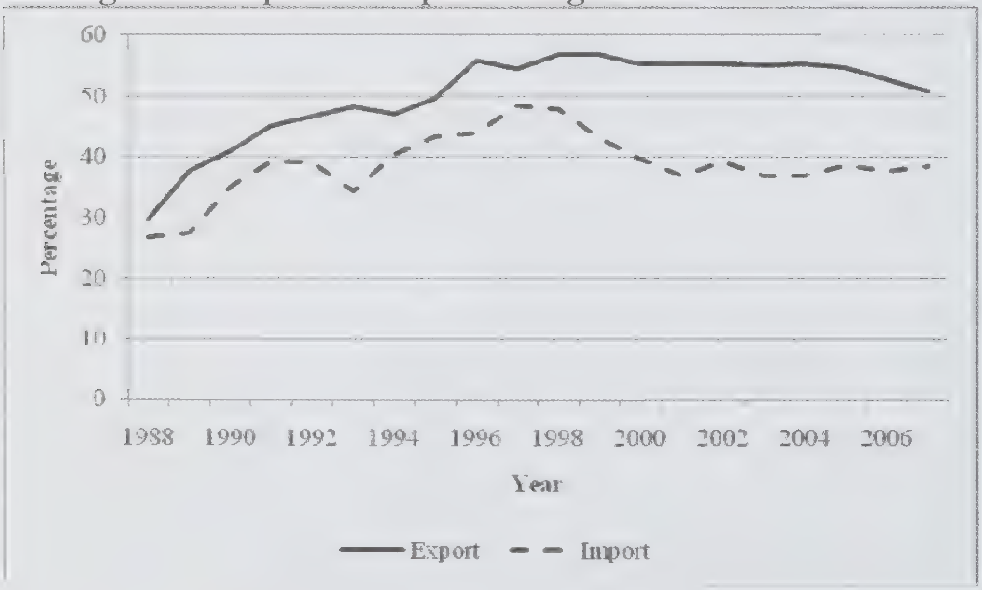
1. China's Role in Global Production Networks

1.1 China's Dualistic Foreign Trade Regime

China's rapid emergence as an export powerhouse has attracted large attention in both academic and policy circles. In the past 20 years, China's exports have grown at an annualized rate of 19 percent, more than twice the rate of growth of world exports. As a result, China's share of world exports has surpassed Japan and the United States to become the world's second largest exporter after Germany.

A key driver of China's export growth has been the success of its processing trade regime (Branstetter and Lardy, 2006; Amiti and Freund, 2008; Dean, Lovely and Mora, 2009; Ma, Van Assche and Hong, 2009). Under this regime, the Chinese government grants firms duty exemptions on imported raw materials and other inputs as long as they are used solely for export purposes. Many firms (including Canadian) have taken advantage of this regime to integrate China in their global production networks by offshoring labor-intensive final-assembly activities to the country. Data provided by China's Customs Statistics show the large and growing importance of the processing trade regime. As it is shown in Figure 1, the share of processing exports (i.e. exports conducted under the processing regime) in China's total exports has risen from 30% in 1988 to 51% in 2007, while the share of processing imports in total imports has increased from 27% to 38% over the same period.

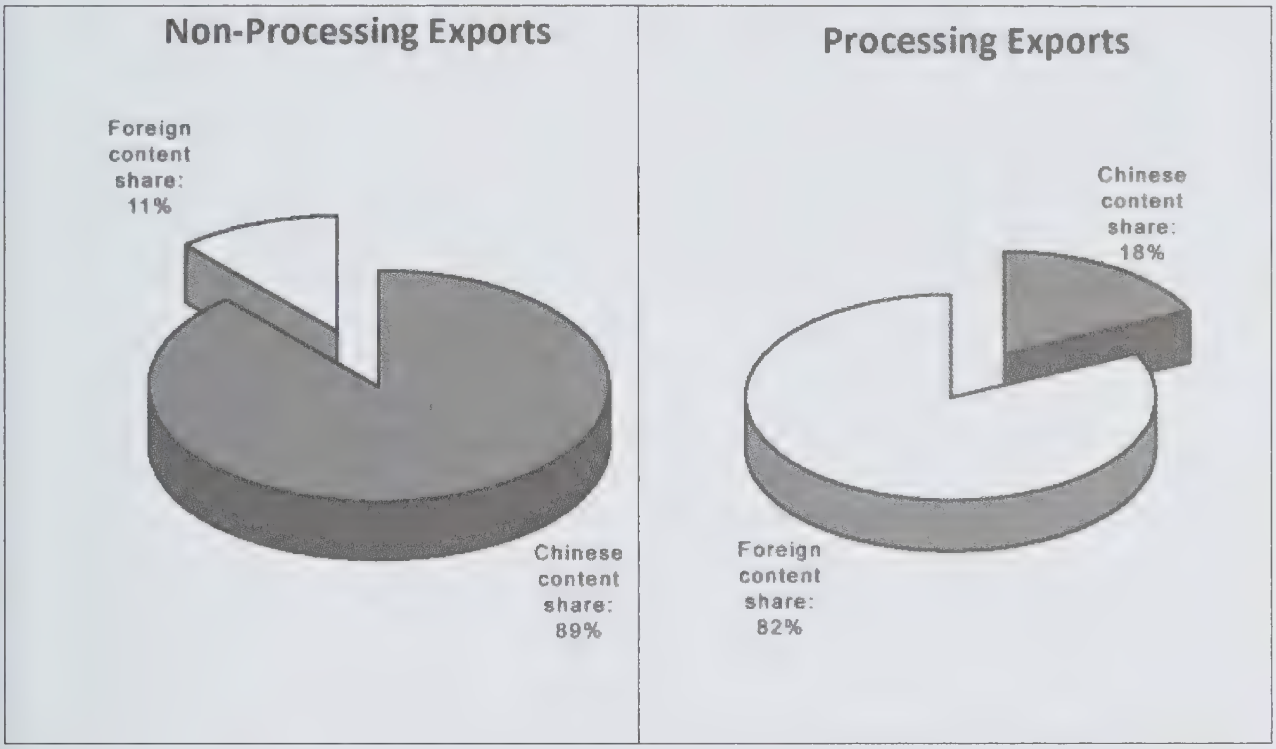
Figure 1: Proportion of processing trade in China's total trade, 1988-2007



Source: Authors' calculations using China's Customs Statistics.

Processing exports differ from non-processing exports in three important ways. First, processing exports rely more heavily on imported inputs than non-processing exports. In a recent paper, Koopman, Wang and Wei (2008) combined the China Customs Statistics trade data with an input-output table for China to estimate the domestic content share of China's processing and non-processing exports. As it is shown in Figure 2, they found that, in 2006, the domestic content share of processing exports was a low 18.1%, implying that the value of imported inputs accounted for 81.9% of the processing export value. Conversely, the domestic content share of non-processing exports stood at a much higher 88.7%, meaning that imported inputs only represented 11.3% of the export value.

Figure 2: Domestic and foreign content share of China's processing and non-processing exports



Source: Koopman, Wang and Wei (2008).

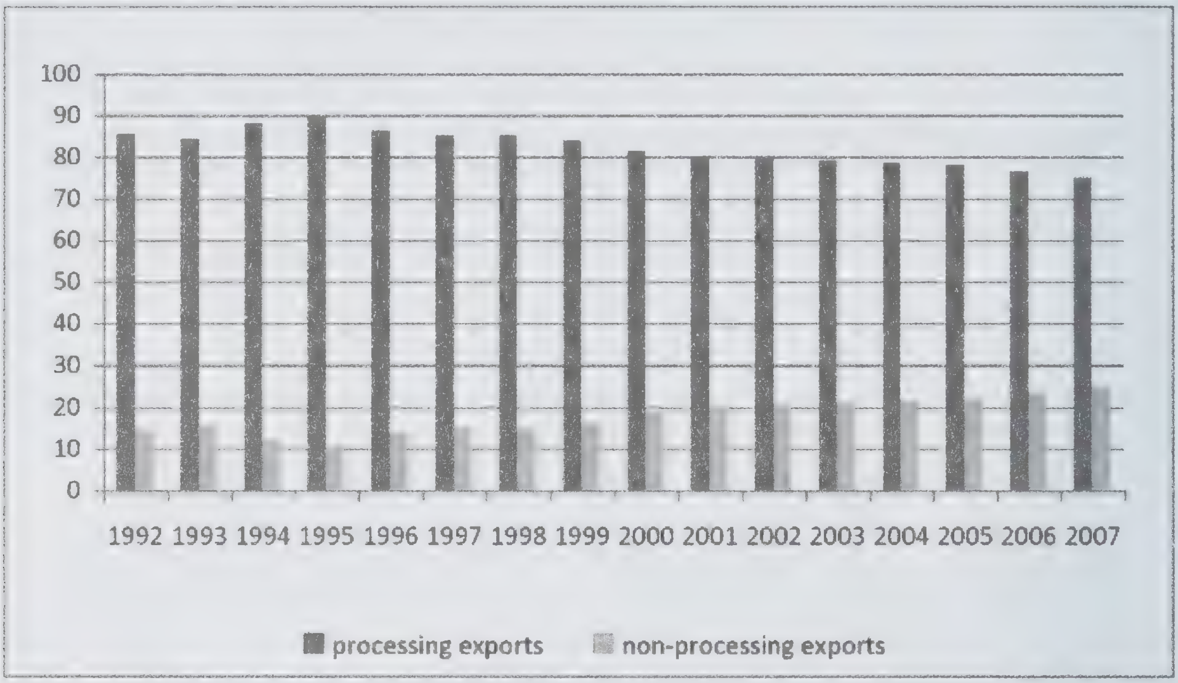
Second, processing exports are predominantly conducted by foreign invested enterprises (FIEs),[1] whereas non-processing exports are largely conducted by local firms. Between 1992 and 2007, the share of processing exports conducted by FIEs has varied from a high of 89.7% in 1995 to a low of 75.0% in 2007 (see Figure 3). Conversely, FIEs' share of non-processing exports has consistently remained below 25%.

Third, processing exports are concentrated in higher technology categories than non-processing exports. To demonstrate this, we have used the Organization of Economic Cooperation and Development's (OECD) technology classification (Hatzichronoglou, 1997) to disaggregate China's exports into four categories: high technology exports, medium-high technology exports, medium-low technology exports and low technology exports. In Figure 4, we depict the share of processing exports in China's total exports for

[1] Foreign-invested enterprises include wholly foreign-owned enterprises, sino-foreign contractual joint ventures with more than 25% foreign ownership, and sino-foreign equity joint ventures with more than 25% foreign ownership. Note that in China's Customs Statistics, companies from Hong Kong, Macau and Taiwan are considered foreign firms.

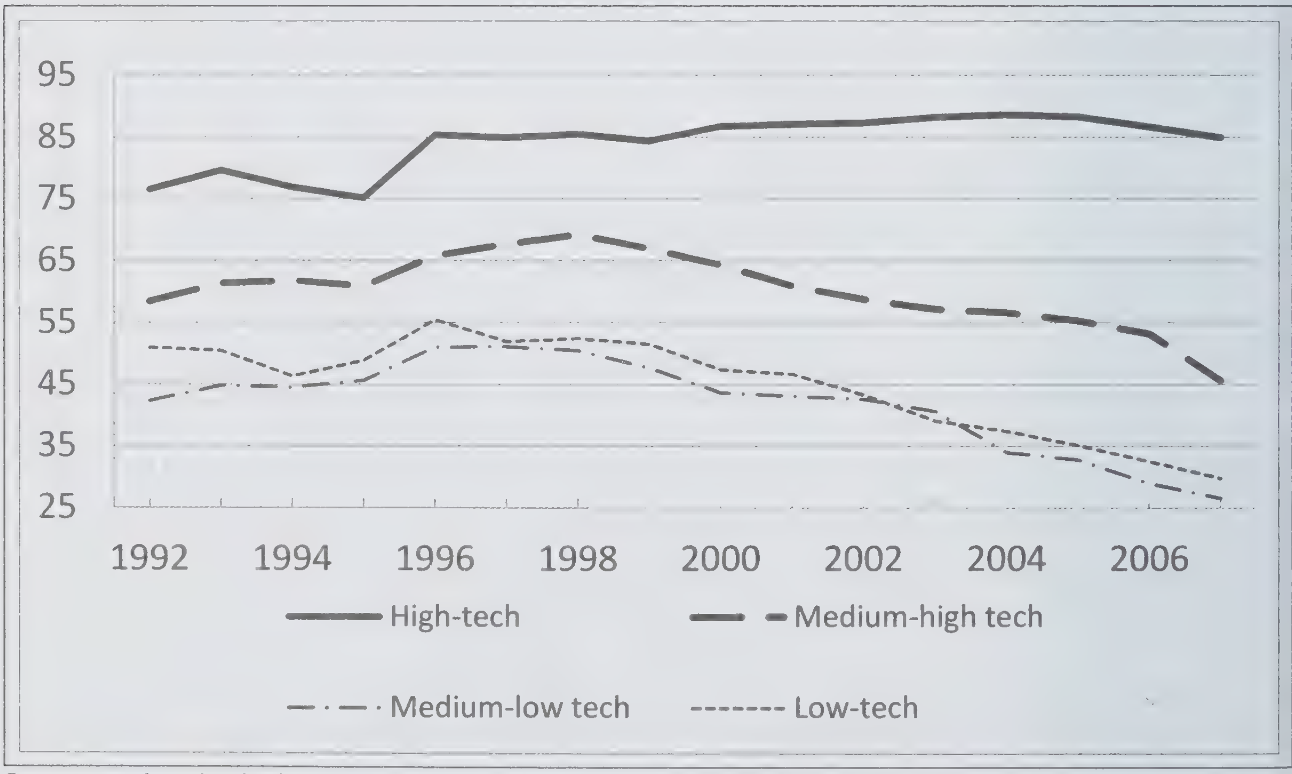
each technology category. Tellingly, processing exports are more important in higher technology categories than in lower technology categories. In 2007, processing exports accounted for 84.9% of high-technology exports; 45.6% of medium-high-technology exports; 26.6% of medium-low-technology exports; and 29.8% of low-technology exports.

Figure 3: Share of China's exports conducted by foreign-invested enterprises, 1992-2007



Source: authors' calculations, using China's Customs Statistics.

Figure 4: Share of processing exports in China's total exports, by technology level (%)



Source: authors' calculations, using China's Customs Statistics

These distinctions between processing trade and non-processing trade suggest that China's foreign trade regime has effectively turned into a dualistic system. In higher technology industries, foreign firms have on a large scale used China's processing trade regime to integrate the country into their global production networks. In these industries, China heavily relies on imported inputs and is primarily responsible for the labor-intensive downstream activities such as assembly. Conversely, in lower technology industries, China is relatively uninvolved in global production networks, with its exports largely conducted outside the processing trade regime by domestic firms that source their inputs locally.

1.2 China as East Asia's Export Platform

The processing trade data from China's Customs Statistics provide a direct view of the structure of the global production networks in which China has been integrated.[2] For each processing location in China, the data set provides a unique mapping of the source countries where processing inputs are imported from and the destination countries of processed exports.[3] This makes it possible to examine the role of both the location's proximity to foreign input suppliers and its vicinity to destination markets on China's attractiveness as a processing location. Such analysis cannot be conducted with regular trade data since imports are not necessarily used solely for export purposes.

An important data issue that needs to be addressed when analyzing the countries of origin of processing imports and the destination countries of processing exports is that transshipments account for about 90% of China's trade with its largest trading partner, Hong Kong (Feenstra, Hai, Woo and Yao, 1999; Feenstra, Hanson and Lin, 2004; Ferrantino and Wang, 2007). To account for these transshipments, we follow Ma, Van Assche and Hong (2009) and link the processing trade data from China's Customs Statistics to a data set from the Hong Kong Census and Statistical Office on Hong Kong re-exports. This allows us to estimate the country of origin of transshipped processing imports and the destination country of transshipped processing exports. A comparison of columns 3 and 4 in Tables 1 and 2 illustrates the impact of adjusting for transshipments through Hong Kong on China's processing trade with its major trading partners. While Hong Kong's role becomes insignificant, it almost doubles the share of processing imports originating from China's other major trading partners and increases by a quarter the share of processing exports destined to these same countries.

On the import side, column 3 of Table 1 shows that China heavily sourced its inputs from its neighboring East Asian countries, with 76.1% of its processing imports originating from within East Asia in 2007. By contrast the United States, EU-19[4] and Canada contributed relatively little to the supply of processing inputs, together accounting for less than 17% of processing imports in 2007. This asymmetric sourcing pattern of processing inputs has become more pronounced over time. Between 1997 and 2007, the share of processing imports originating from China's most important East Asian trading

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[2] Hanson, Mataloni and Slaughter (2005) used a different data set on intra-firm trade by U.S. multinational firms to analyze the structure of vertical production networks. Our data set has the added advantage that it not only measures intra-firm trade, but also accounts for transactions between firms within the same production network.

[3] See Feenstra, Deng, Ma and Yao (2004) for a detailed description of the data.

[4] The EU-19 include all European Union countries prior to the accession of the 10 candidate countries on 1 May 2004, plus the four eastern European member countries of the OECD, namely Czech Republic, Hungary, Poland, Slovak Republic.

partners has risen from 68.8% to 76.1%, while the share of processing imports originating from non-Asian OECD countries has decreased from 23.8% to 18.1%.

Table 1: Share of China's processing imports by country of origin, 2007 (%)

	Adjusted for Hong Kong transshipments			Unadjusted
	1997	2002	2007	2007
East Asia	**68.8**	**73.3**	**76.1**	**86.6**
Hong Kong	-	-	-	47.1
Japan	26.9	26.5	23.7	10.6
South Korea	15.02	14.1	15.7	10.8
Singapore	3.2	3.4	4.3	2.9
Taiwan	16.9	19.0	20.3	9.6
Malaysia	2.2	3.9	4.5	1.5
Thailand	2.0	2.8	2.8	1.3
Philippines	0.2	1.7	3.5	2.1
Vietnam	0.2	0.1	0.2	0.1
Indonesia	1.8	1.3	0.9	0.4
Macau	0.4	0.6	0.3	0.2
Non-Asian OECD	**23.8**	**21.8**	**18.1**	**9.3**
United States	10.4	9.1	7.7	3.9
EU-19	9.0	9.8	7.9	4.1
Canada	0.7	0.5	0.8	0.5
Australia	2.7	1.3	0.8	0.4
Other OECD	1.0	1.1	1.0	0.4
Rest of the World	**7.3**	**4.9**	**5.8**	**4.1**

Source: Authors' calculations, using China's Customs Statistics data.

On the export side, an opposite pattern has emerged. The majority of processed goods are destined outside of the East Asian region, and this portion has increased over time. As is shown in Table 2, the share of processing exports destined to non-Asian OECD countries has risen from 54.7% in 1997 to 61.8% in 2007. Conversely, the share of processing exports destined within the East Asian region has declined from 36.0% in 1997 to 29.2% in 2007.

A growing literature attributes this unbalanced processing trade pattern to the reorganization of production in East Asia (Yoshida and Ito, 2006; Gaulier, Lemoine and Ünal-Kesenci, 2007; Haddad, 2007). With rising costs in Japan and the Newly Industrialized Economies (NIEs) – Taiwan, Singapore, South Korea and Hong Kong – East Asian firms are increasingly using China as a lower cost export platform. Instead of directly exporting their final goods to the Western markets, these firms now export high

value intermediate goods to their processing plants in China and then export it on to the West after assembly. As a result, a triangular trade pattern has emerged in global production networks in which China heavily relies on processing inputs from East Asia, while predominantly sending processed goods to the West.

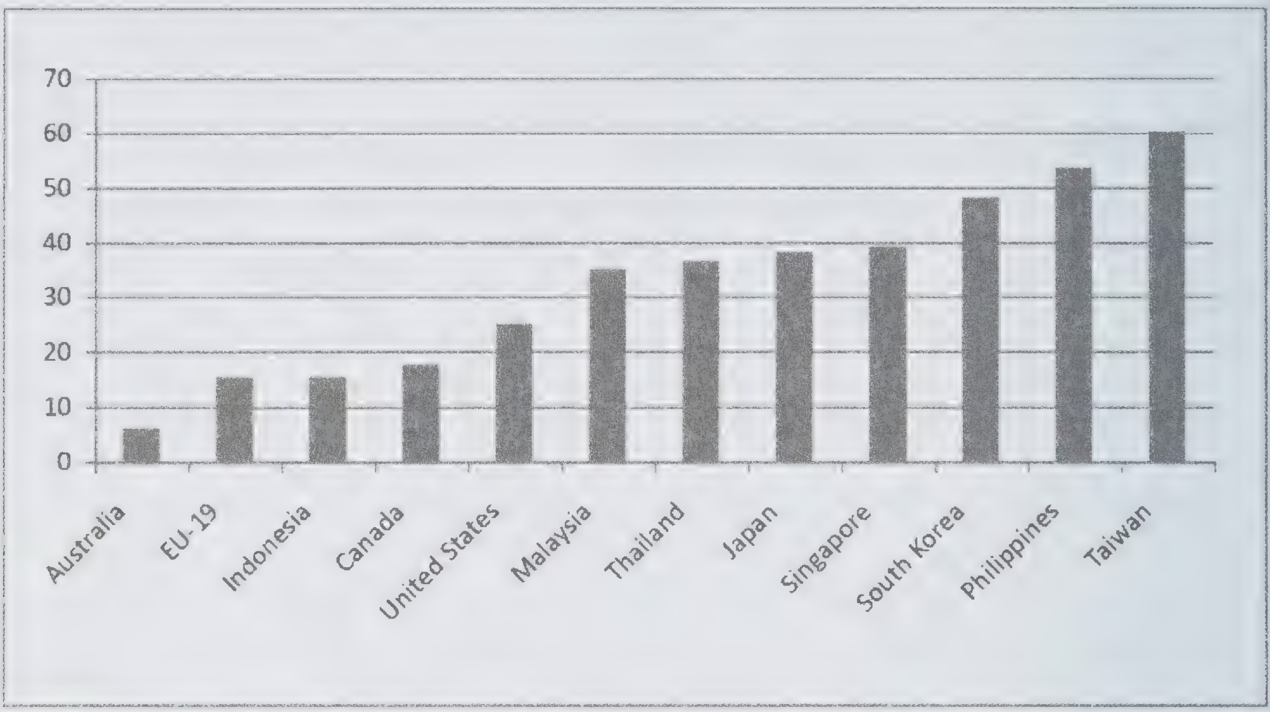
Table 2: Share of China's processing exports by destination country, 2007 (%)

	Adjusted for Hong Kong transshipments			Unadjusted
	1997	2002	2007	2007
East Asia	**36.0**	**33.4**	**29.2**	**51.4**
Hong Kong	-	-	-	32.8
Japan	18.6	15.9	11.4	7.9
South Korea	5.0	4.8	5.0	3.7
Singapore	3.6	3.6	3.7	2.3
Taiwan	2.4	2.3	2.6	1.5
Malaysia	1.7	2.1	2.0	1.4
Thailand	1.3	1.5	1.3	0.6
Philippines	1.3	1.3	1.1	0.4
Vietnam	0.5	0.5	0.6	0.3
Indonesia	0.9	0.7	0.7	0.4
Macau	0.7	0.6	0.7	0.2
Non-Asian OECD	**54.7**	**59.9**	**61.8**	**42.0**
United States	28.9	32.4	28.8	20.1
EU-19	20.1	22.1	27.2	18.1
Canada	1.8	1.8	1.8	1.1
Australia	1.7	1.6	1.7	1.1
Other OECD	2.1	2.0	2.4	1.6
Rest of the World	**9.4**	**6.7**	**9.0**	**6.6**

Source: Authors' calculations, using China's Customs Statistics data.

Data on the bilateral intensity of China's processing trade provide further evidence of this triangular trade structure in East Asian production networks. As it is shown in Figure 5, East Asian countries more intensively supply China with processing inputs than countries outside of East Asia. Except for Indonesia, more than 35% of China's imports from its major East Asian trading partners were processing imports in 2007 (see Figure 5). Almost 40% of its imports from Japan and between 40% and 65% of its imports from the Newly Industrialized Economies (South Korea, Taiwan and Singapore) were aimed at supplying inputs for processing industries. This is a significantly higher share than for Western countries. The share of processing imports in China's total imports from the EU-19, Canada and the United States amounted to 15.4%, 17.6% and 25.0%, respectively.

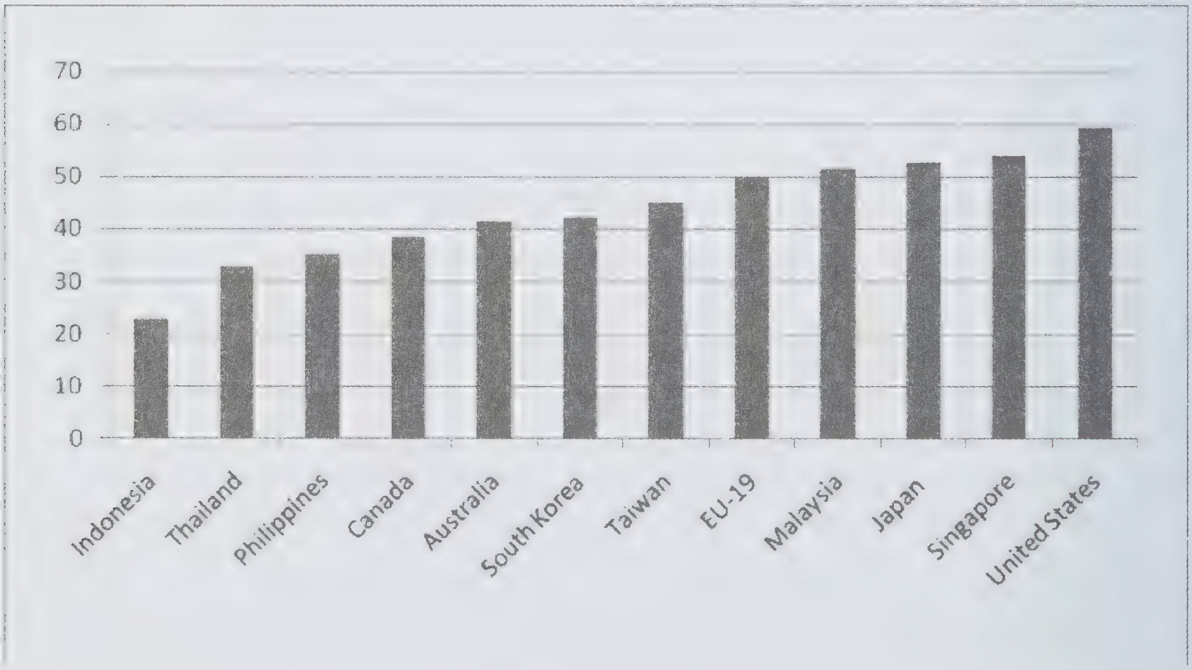
Figure 5: Processing imports as a share of China's total imports, by country of origin, 2007 (%)



Source: authors' calculations, using China's Customs Statistics

At the same time, China more intensively supplies processed goods to developed countries than to its East Asian neighbors. As is show in Figure 6, more than 50% of the exports that China sends to the United States, the EU-19 and Japan are processing exports.[5] For most developing East Asian countries the number is significantly lower.

Figure 6: Processing exports as a share of China's total exports, by destination country, 2007 (%)

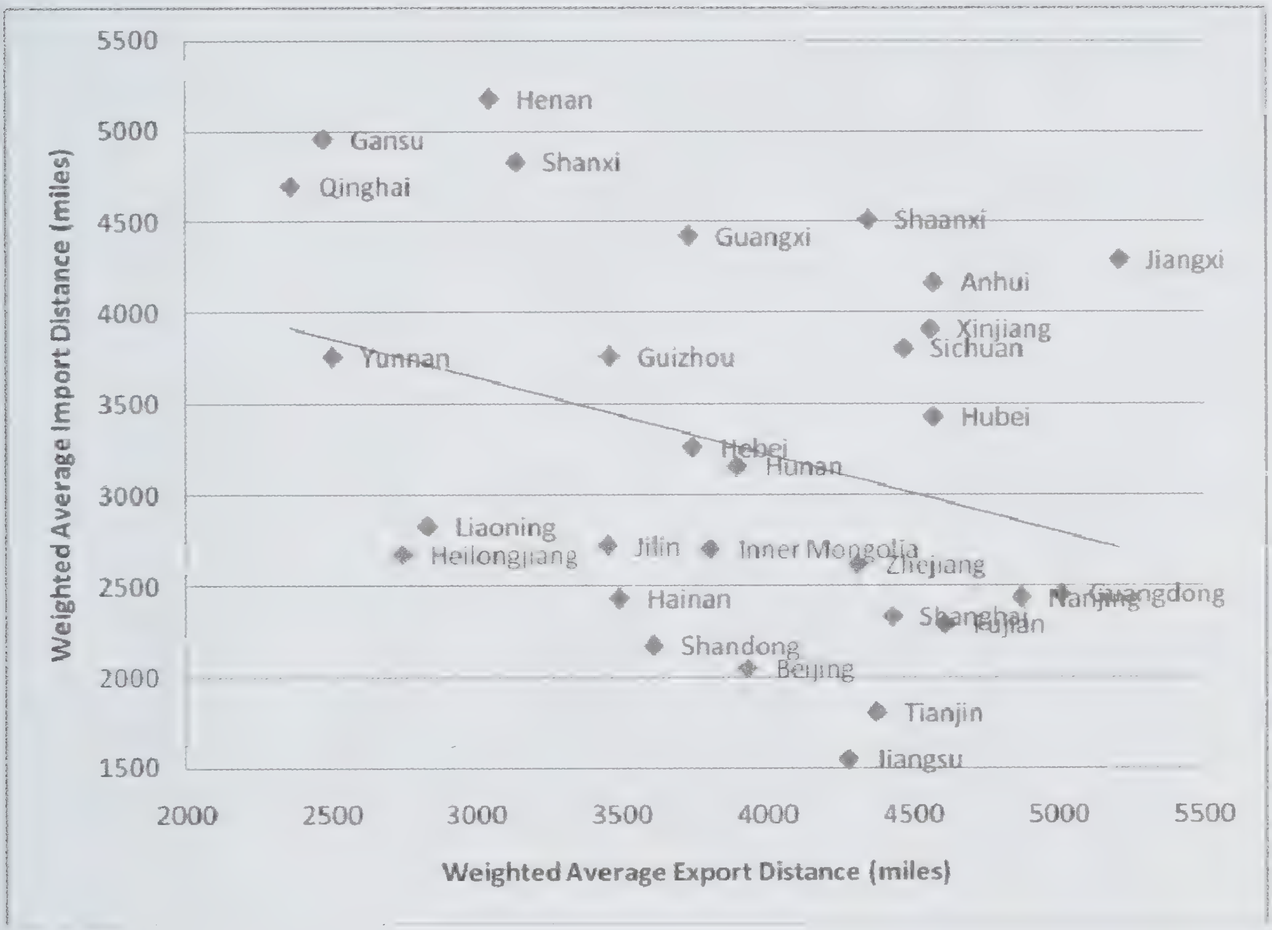


Source: authors' calculations, using China's Customs Statistics

[5] Canada is an exception. Only 38% of China's exports to Canada are processing exports.

The triangular trade pattern suggests that China is primarily used as an export platform by East Asian firms that sell their goods to Western markets. In a recent paper, however, Ma, Van Assche and Hong (2009) show that China is also used by non-Asian firms that sell their products to East Asian markets. Their analysis was spurred by the observation that, in a cross-section of 29 Chinese provinces, the weighted average distance traveled by processing imports (import distance) has been negatively correlated to the weighted average distance travelled by processing exports (export distance) for all years from 1997 to 2007. In other words, locations in China that import their processing inputs from nearby tend to export their processed goods far away and vice versa (see Figure 7).

Figure 7: Weighted average distance traveled by China's processing exports versus weighted average distance traveled by its processing imports, by province, 2007

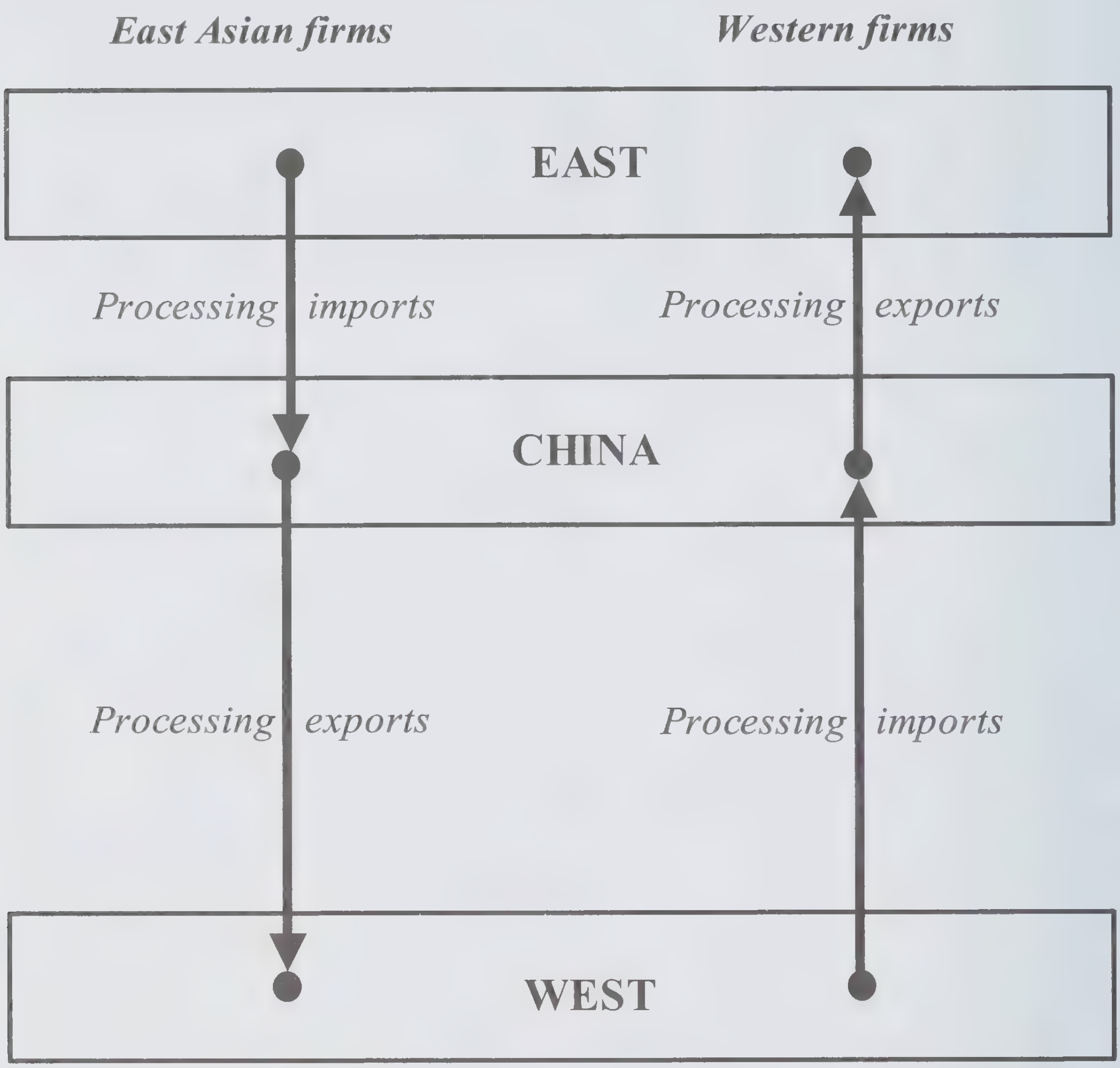


Source: authors' calculations, using China's Customs Statistics

To explain this spatial trend, Ma, Van Assche and Hong (2009) built on a literature of export platform FDI (Ekholm, Forslid and Markusen, 2003; Yeaple, 2003; and Grossman, Helpman and Szeidl, 2006) to develop a theoretical model consisting of three countries: *East* (for advanced East Asian countries), *West* (for Europe and North America), and *China*. In their model, multinational firms from the two advanced regions, *East* and *West*, sell differentiated goods in each other's markets. Each firm can use two modes to serve the other market. It can produce its goods at home and directly export it to the other market. Alternatively, it can indirectly export its goods to the other market by assembling it in the low cost country, *China*. As is shown in Figure 8, since *China* is located in the vicinity of *East*, the model provides an explanation for the negative correlation between

export and import distance for *China*'s processing trade: the inputs that *China* imports from nearby *East* are processed into final goods and exported to the far-away *West*. Conversely, the inputs that *China* imports from the far-away *West* are processed into final goods and exported to the nearby *East*.

Figure 8: China as an export platform



Source: Ma, Van Assche and Hong (2009)

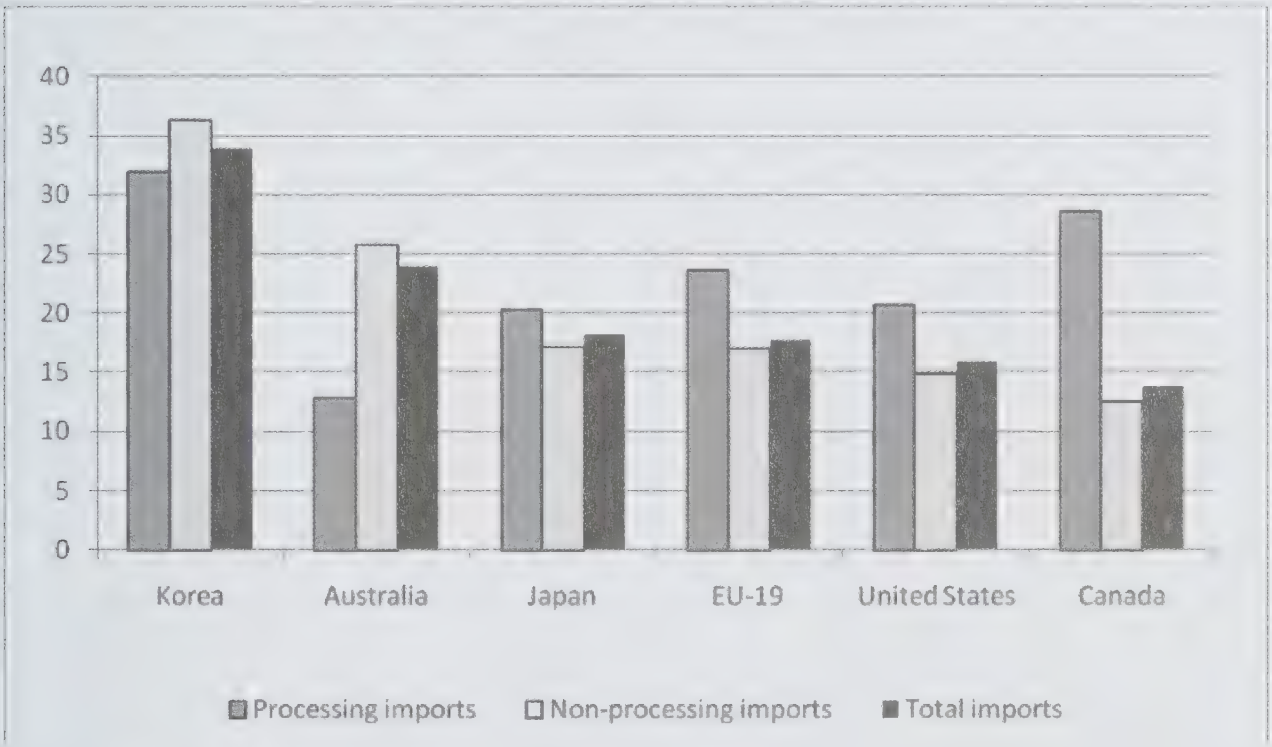
The theoretical model predicts that distance should affect the attractiveness of China as a processing location differently for *Eastern* and *Western* firms. For *Eastern* firms, the key distance factor that determines *China*'s attractiveness as a processing location is its vicinity to foreign input suppliers, i.e. import distance. The larger is import distance, the less attractive *China* becomes as a location for processing activities and therefore the less processed goods *China* exports. Conversely, for *Western* firms, the critical distance determinant of *China*'s attractiveness as a processing location is its proximity to the East Asian market, i.e. export distance. The larger is export distance, the less attractive *China* becomes as a location for processing activities. Using the China Customs Statistics data on processing trade, the study finds empirical support that processing exports to East Asian countries are more sensitive to export distance and less sensitive to import distance than its processing exports to non-Asian OECD countries.

The empirical evidence suggests that China's attractiveness as a labor-intensive offshoring location is not only due to low labor costs and aggressive export promotion policies, but is also driven by its geographic location. Production networks centered in East Asia consider China's proximity to input suppliers in the East Asian region to be a driving factor of their offshoring decisions. Conversely, production networks centered in the West deem China's vicinity to East Asian markets as a main determinant of their offshoring decisions.

1.3 The Canada-China Nexus in Global Production Networks

Despite its heavy reliance on processing inputs from within East Asia, the large and growing role of China's processing trade regime continues to provide important growth opportunities to Western businesses. As it is shown in Figure 9, over the period 1992-2007, China's processing imports from Canada have grown by a stellar 28.6%, which is more than double Canada's exports growth to China, and almost quadruple Canada's overall exports growth. Processing imports from the EU-19 and the United States have seen similar growth rates of 23.6% and 20.7% respectively.

Figure 9: Growth rates of China's processing imports, non-processing imports and total imports, by country of origin (%)



Source: authors' calculations, using China's Customs Statistics

The extent of Western countries' involvement in China's processing trade regime remains nonetheless limited. In 2007, the share of Western countries' exports that were destined for China's processing trade regime varied from 0.15% to 0.62% (see Table 3). In comparison, 2.72% of Japanese exports and 5.34% of South Korean exports where processing inputs destined to China.

Table 3: Share of exports destined to China's processing trade regime (%)

	1992	2007
South Korea	0.41	5.34
Japan	0.35	2.72
United States	0.10	0.62
Australia	0.29	0.53
Canada	0.01	0.20
EU-19	0.04	0.15

Source: Authors' calculations, using China's Customs Statistics and WITS data.

Furthermore, the composition of processing inputs supplied to China varies significantly across Western countries. The processing inputs that Canada supplies to China are decidedly less sophisticated than that of other major Western nations. The import RCA indices presented in Table 4 demonstrate this. Between 1992 and 2007, Canada has acquired a strong specialization in the exports of low-technology and medium-low-technology products to China's processing trade regime. Conversely, Canada is less specialized in the supply of medium-high-technology inputs and especially high-technology components than the rest of the world, and this trend has worsened over time. An important driver of this trend has undoubtedly been the rise in commodity prices between 2003 and mid-2007. Owing to Canada's strong comparative advantage in natural resources, the price rise has led to an explosion in Canada's export value of 'metals' and 'paper and paper products' to China's processing trade regime. Whereas these two sectors in 1992 only accounted for 12% of the processing inputs that China imported from Canada, it has grown to more than 50% in 2007.

Nonetheless, the marginal and declining share that high-technology inputs take in China's processing imports from Canada is a reason for concern. In 2007, high technology inputs accounted for only 4.4% of China's processing imports from Canada. In comparison, high-technology inputs accounted for 48.5% of U.S. processing inputs sent to China, and 34.5% of EU-19 processing inputs sent to China (see Table 5).[6]

Table 4: China's processing imports from Canada, by technology level

	China's processing imports from Canada (US$mill.)		Growth in processing imports from Canada (%)	Share of Canadian processing imports (%)		Import RCA index*	
	1992	2007	1992-2007	1992	2007	1992	2007
High technology	**5.4**	**73.7**	19.1	**13.7**	**4.4**	**0.96**	**0.08**
Aircraft	4.7	19.7	10.1	11.9	1.2	151.49	14.30
Pharmaceuticals	0.1	0.0	-9.5	0.3	0.0	2.61	0.02

[6] The EU-19's involvement in China's processing trade regime is underestimated since a large portion of EU-19 high technology exports are intra-regional exports. If intra-regional exports are excluded, the EU-19's degree of involvement would be significantly higher.

	China's processing imports from Canada (US$mill.)		Growth in processing imports from Canada (%)	Share of Canadian processing imports (%)		Import RCA index*	
	1992	2007	1992-2007	1992	2007	1992	2007
Office and computing machinery	0.1	6.5	33.9	0.2	0.4	0.12	0.09
Radio, TV and comm. Equipment	0.5	34.9	32.8	1.3	2.1	0.15	0.06
Medical, precision and optical ins.	0.0	12.5	74.3	0.0	0.7	0.00	0.06
Medium-high technology	**2.3**	**86.6**	**27.4**	**5.9**	**5.1**	**0.48**	**0.35**
Electrical machinery	0.8	25.3	26.5	1.9	1.5	0.38	0.22
Motor vehicles	0.0	14.1	74.9	0.0	0.8	0.02	3.31
Chemicals	0.2	11.1	30.0	0.6	0.7	0.22	0.26
Other transport equipment	0.1	1.0	18.7	0.2	0.1	0.45	0.84
Machinery and equipment	1.3	35.1	24.8	3.2	2.1	0.84	0.41
Medium-low technology	**3.0**	**626.7**	**42.8**	**7.7**	**37.1**	**0.55**	**3.26**
Shipbuilding and repairing	0.0	0.0	-	0.0	0.0	0.00	0.00
Rubber and plastic products	0.2	16.1	34.0	0.5	1.0	0.17	0.52
Petroleum products	0.0	0.1	25.0	0.0	0.0	0.03	0.07
Non-metallic mineral products	0.1	1.7	23.3	0.2	0.1	0.31	0.13
Metal products	2.7	608.8	43.4	7.0	36.0	0.70	4.15
Low technology	**18.2**	**429.5**	**23.5**	**46.6**	**25.4**	**1.18**	**3.05**
Manufacturing	0.1	1.1	19.8	0.2	0.1	0.07	0.07
Paper and paper products	2.0	312.0	40.2	5.0	18.5	0.95	13.01
Printing and publishing	0.0	1.0	24.5	0.1	0.1	0.68	1.06
Food, beverages and tobacco	0.4	87.5	42.5	1.1	5.2	0.56	6.35
Textiles, apparel and leather	15.7	28.0	4.0	40.2	1.7	1.37	0.32
Other	**10.2**	**474.1**	29.2	**26.1**	**28.1**	**1.29**	**2.21**
Total	**39.0**	**1690.6**	**28.6**	**100.0**	**100.0**	**1.00**	**1.00**

Source: Authors' calculations, using China's Customs Statistics data.

* The import RCA index is calculated as the ratio of two ratios, the ratio of processing imports from an economy for each subsection to total processing imports from that economy, relative to the ratio of world processing imports for each corresponding section to world total processing imports.

Table 5: Share of China's Processing Imports, by country and technology level, 2007 (%)

	Canada	Australia	United States	EU-19	Japan	South Korea	Total
High technology	4.4	3.2	48.5	34.5	53.8	40.3	52.9
Aircraft	1.2	0.0	0.7	1.6	0.0	0.0	0.1
Pharmaceuticals	0.0	0.0	0.2	1.0	0.0	0.3	0.1
Office and computing machinery	0.4	0.1	2.5	1.1	1.6	1.2	4.4
Radio, TV and comm. Equipment	2.1	2.9	41.4	27.0	30.7	29.2	36.3
Medical, precision and optical instr.	0.7	0.2	3.7	3.7	21.5	9.6	12.0
Medium-high technology	5.1	1.9	11.0	39.4	13.2	21.6	14.7
Electrical machinery	1.5	0.6	3.5	11.3	7.2	9.5	6.8
Motor vehicles	0.8	0.3	0.6	1.7	0.5	0.8	0.3
Chemicals	0.7	0.3	2.9	3.9	1.5	3.4	2.5
Other transport equipment	0.1	0.2	0.1	0.1	0.0	0.1	0.1
Machinery and equipment	2.1	0.5	3.9	22.4	4.0	7.9	5.1
Medium-low technology	37.1	33.2	10.9	5.2	12.5	20.1	11.4
Shipbuilding and repairing	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Rubber and plastic products	0.9	0.9	2.1	3.0	3.0	4.0	1.8
Petroleum products	0.0	0.2	0.7	0.3	0.0	0.0	0.1
Non-metallic mineral products	0.1	1.1	0.8	1.9	0.5	1.6	0.8
Metal products	36.0	31.1	7.2	0.0	9.1	14.4	8.7
Low technology	25.4	22.5	14.3	27.6	7.6	9.2	8.3
Manufacturing	0.1	0.0	0.4	1.1	0.4	0.9	0.9
Paper and paper products	18.5	5.7	6.5	5.7	0.5	0.9	1.4
Printing and publishing	0.1	0.0	0.1	0.0	0.0	0.1	0.1
Food, beverages and tobacco	5.2	8.0	1.9	5.6	0.7	0.6	0.8
Textiles, apparel and leather	1.7	8.8	5.3	25.5	5.9	6.7	5.2
Other	28.0	39.2	15.3	21.0	12.8	8.7	12.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Authors' calculations, using China's Customs Statistics data.

Canada's marginal role in supplying high-technology inputs to China's processing trade regime is further demonstrated in the right-hand panel of Table 6. In 2007, only 0.09% of Canada's high technology exports were destined to China's processing trade regime. In contrast, the United States and EU-19 exported 1.08% and 0.21% of their high-technology products to China's processing trade regime, respectively. This lack of involvement is consistent across high-technology subcategories. In 'Radio, TV and Communications Equipment', for example, a sector in which Canada is considered highly competitive, Canada only exports 0.17% to China's processing trade regime, whereas the United States and the EU-19 export 3.52% and 0.65% respectively. More research is needed to determine the causes of Canadian firms' lack of involvement in the global production networks that use China as a processing location.

Table 6: Share of Western countries' high-technology exports destined to China and to China's processing trade regime, by category (%)

	Share of Canada's exports of category *i* that is destined for China (%)		Share of Canada's exports of category *i* destined for China's processing trade regime (%)	
	1992	2007	1992	2007
Aircraft	0.59	0.44	0.07	0.07
Pharmaceuticals	0.22	0.07	0.02	0.00
Office and computing machinery	0.06	0.90	0.00	0.08
Radio, TV and comm. Equipment	0.96	0.94	0.01	0.17
Medical, precision and optical instr.	0.42	1.53	0.00	0.12
High technology	**0.54**	**0.71**	**0.02**	**0.09**
	Share of US exports of category *i* that is destined for China (%)		Share of US exports of category *i* destined for China's processing trade regime (%)	
	1992	2007	1992	2007
Aircraft	2.55	2.46	0.02	0.05
Pharmaceuticals	0.32	0.63	0.02	0.03
Office and computing machinery	0.28	2.49	0.00	0.43
Radio, TV and comm. Equipment	0.36	4.73	0.02	3.52
Medical, precision and optical instr.	1.09	2.46	0.02	0.39
High technology	**1.19**	**3.31**	**0.02**	**1.08**

	Share of EU-19 exports of category *i* that is destined for China (%)		Share of EU-19 exports of category *i* destined for China's processing trade regime (%)	
	1992	2007	1992	2007
Aircraft	0.29	3.21	0.00	0.08
Pharmaceuticals	0.21	0.36	0.00	0.02
Office and computing machinery	0.05	0.56	0.00	0.05
Radio, TV and comm. Equipment	0.41	1.23	0.01	0.65
Medical, precision and optical instr.	0.41	1.44	0.01	0.12
High technology	**0.28**	**1.14**	**0.01**	**0.21**

Source: Authors' calculations, using China's Customs Statistics and WITS data.

In sum, we have in this section conducted an anatomy of China's processing trade to understand the structure of global production networks that operate processing activities in China. We have identified that a representative global production network that conducts processing activities in China operates in a high technology industries, relies heavily on imported inputs from within the East Asian region, and uses China as an export platform to sell its products in Western markets. But we have also seen that other types of global production networks exist that import components from far to assemble them in China and sell them in East Asian markets. Finally, we have seen that, compared to other Western countries, Canada plays a relatively minor role in supplying China with high-technology processing inputs. Only in the relatively less sophisticated natural resource-intensive industries 'metals' and 'paper and paper products' have they become major suppliers.

3. Implications for China's Role in World Trade

Our analysis of China's role in global production networks allows us to gain new insights into the nature of China's growing role in world trade. First and foremost, it shows that – especially in high technology industries – China's exports do not reflect production activities that have taken place in the country, but also encompasses production activities that have occurred in the countries from which inputs have been imported. As a result, variations in China's export performance may not be due to changes in China's economic environment, but also because of fluctuations in the economic environments of the countries from which China imports its inputs.

Recent studies have relied on this intuition to re-examine the causes and consequences of economic shocks to China's external trade. Amiti and Davis (2009) showed that the source of the rising Chinese export prices between 2006-2008 was not the increase in Chinese wages as had been widely reported, but was rather the surge in the prices of commodities that China heavily imported from abroad. The Congressional Budget Office (2008) argued that the effect of an appreciation of China's currency on China's exports to the United States would likely be muted since it would only affect the dollar price of the domestic content of Chinese exports. It would not affect the portion of the exports' value attributable to the cost of imported inputs unless the countries that supply those inputs allowed their currencies to rise in value as well.

In this Section, we will build further on these insights to reevaluate the technological upgrading trajectory of China's exports and to examine the effect of the recent economic crisis on China's international trade patterns.

3.1 China's Technological Upgrading Path

In Canada, a key public concern related to China's economic rise is that its exports mix is upgrading rapidly from low-end products such as clothing to high-end products such as electronics and telecommunications equipment. This has led to the fear that China is rapidly moving up the technology ladder and becoming competitive in technology-intensive areas where advanced economies such as Canada should have a comparative advantage.

If China's integration into global production networks is not taken into account, the evidence of this technological upgrading of China's exports seems compelling. In Table 7, we have disaggregated China's exports by technology category to analyze its export specialization patterns between 1992 and 2007. To measure a country's intensity of export specialization across technology categories, economists often use revealed comparative advantage (RCA) indices.[7] An export RCA value that exceeds unity implies that a country has a greater-than-average share of exports in that technology category, thus suggesting that it has a revealed comparative advantage. Conversely, if the export RCA is smaller than unity, it implies that the country has a revealed comparative disadvantage. Between 1992 and 2007, China's export specialization has changed significantly. In 1992, China had a specialization pattern that was consistent with its status as a developing country. With low technology exports accounting for 53.3% of its exports, it only had a revealed comparative advantage (RCA>1) in low technology exports. Between 1992 and 2007, however, China's exports growth has been particularly large in the higher technology categories. High technology exports grew 21.2% per year; medium-high technology exports grew 18.3% per year; medium-low technology exports grew 15.9% per year; and low technology by 8.3%. As a result, by 2007, China's export specialization pattern had upgraded dramatically, with the high technology and medium-high technology exports accounting for more than half of China's exports. As a result, China not only had a revealed comparative advantage in low technology exports, but had also garnered a revealed comparative advantage in medium-low technology exports and high technology exports.

Reflecting these trends in exports, a number of academic papers have estimated that China's export mix has been upgrading more rapidly than one would expect from a developing country. Rodrik (2006) and Hausmann, Hwang and Rodrik (2007), for example, found that the bundle of goods that China exports is similar in sophistication to exports of countries with income levels three times higher than that of China, thus leading Rodrik (2006) to conclude that "China has somehow managed to latch on to advanced, high productivity products that one would not normally expect a poor, labor abundant country like China to produce, let alone export." Using a similar logic, Schott (2006) has used Finger and Kreinin's (1979) export similarity index to demonstrate that China's exports are surprisingly similar to the export structure of OECD countries. This has led

[7] The export RCA index is calculated as the ratio of two ratios, the ratio of exports for each subsection of exports in an economy to that economy's total exports, relative to the ratio of world exports for each corresponding section to world total exports. The index reveals the pattern of export specialization for an economy relative to worldwide patterns. The greater a sector's RCA, the more an economy specializes in that sector's exports relative to world specialization patterns.

Schott (2006) to conclude that "China's export bundle increasingly overlaps with that of more developed countries, rendering it more sophisticated than countries with similar endowments."

Table 7: China's Exports, by technology level

	Export share (%)		Growth rate (%) 1992-2007	RCA index	
	1992	2007		1992	2007
High technology	**10.4**	**31.3**	**21.2**	**0.6**	**1.6**
Aircraft	0.5	0.2	5.8	0.2	0.1
Pharmaceuticals	1.2	0.7	9.6	0.8	0.2
Office and computing machinery	1.3	12.1	29.8	0.3	3.7
Radio, TV and comm., Equipment	4.7	14.9	21.6	0.8	1.8
Medical, precision and optical instr.	2.7	3.4	14.7	0.9	1.0
Medium-high technology	**10.2**	**21.0**	**18.3**	**0.4**	**0.8**
Electrical machinery	3.5	5.9	16.8	1.0	1.5
Motor vehicles	0.7	2.7	22.5	0.1	0.3
Chemicals	1.3	1.3	13.3	0.5	0.5
Other transport equipment	0.7	0.8	14.2	1.6	2.0
Machinery and equipment	3.9	10.3	20.1	0.4	1.1
Medium-low technology	**10.2**	**15.1**	**15.9**	**0.8**	**1.1**
Shipbuilding and repairing	0.6	1.0	17.2	1.6	3.1
Rubber and plastic products	2.0	2.5	14.7	0.9	1.1
Petroleum products	0.4	0.3	12.1	0.3	0.6
Non-metallic mineral products	1.9	1.7	12.1	1.4	1.5
Metal products	5.3	9.6	17.4	0.7	1.0
Low technology	**53.3**	**26.5**	**8.3**	**2.5**	**1.7**
Manufacturing	7.3	5.6	11.2	2.3	2.1
Paper and paper products	1.8	1.4	11.8	0.5	0.6
Printing and publishing	0.2	0.3	14.8	0.3	0.8
Food, beverages and tobacco	6.4	1.9	4.9	1.1	0.4
Textiles, apparel and leather	37.5	17.2	7.7	4.5	3.2
Other	**16.0**	**6.1**	**6.5**	**0.7**	**0.2**
Total	**100.0**	**100.0**	**13.1**	**1.0**	**1.0**

Source: Authors' calculations, using WITS data.

This perceived technological upgrading trajectory of China's exports, however, may largely be a statistical mirage. China's exports growth has been concentrated in the higher technology sectors, but these are precisely the sectors in which China's domestic content share is small. As we have seen in Figure 4, 85% of China's high technology exports are in

the processing trade regime, thus implying that they more heavily rely on imported inputs for their exports. Furthermore, Koopman, Wang and Wei (2008, 2009) estimate that the domestic content share of China's exports is especially low in the high-technology industries such as computers, electronic devices, and telecommunication equipment. As a result, China's high technology exports may not reflect the sophistication of the processing activities that take place in China, but rather the technology level of the imported inputs embodied in the processing exports.

We assess this possibility by examining the changing composition of China's non-processing exports.[8] That is, we exclude any exports that have been classified as processing trade. As we have seen in Figure 2, non-processing exports more accurately reflect domestic production activities, with almost 90% of its export value produced in China. In Table 8, we have disaggregated China's non-processing exports according to their technological intensity. The data in the table suggest that China's specialization pattern is in line with its economic development. In both 1992 and 2007, China had a revealed comparative advantage (RCA>1) in the two lowest technology categories and a revealed comparative disadvantage (RCA<1) in the two highest technology categories. These numbers run counter to the suggestion that China's comparative advantage is rapidly shifting from low-technology to high-technology products.

Table 8: China's non-processing exports, by technology level

	Export share (%)		Growth rate (%)	RCA index	
	1992	2007	1992-2007	1997	2007
High technology	**3.9**	**8.2**	**22.5**	**0.23**	**0.42**
Aircraft	0.7	0.0	-2.8	0.30	0.02
Pharmaceuticals	1.8	1.3	14.6	1.28	0.42
Office and computing machinery	0.1	0.4	31.6	0.01	0.14
Radio, TV and comm. Equipment	0.6	5.0	33.8	0.11	0.60
Medical, precision and optical instr.	0.7	1.4	22.2	0.23	0.41
Medium-high technology	**8.0**	**21.4**	**24.4**	**0.31**	**0.84**
Electrical machinery	2.3	5.3	23.3	0.62	1.34
Motor vehicles	0.4	3.3	33.2	0.04	0.35
Chemicals	1.1	1.3	18.2	0.45	0.52
Other transport equipment	0.5	1.3	24.2	1.11	3.13
Machinery and equipment	3.7	10.2	24.6	0.39	1.10
Medium-low technology	**12.0**	**23.1**	**21.9**	**0.91**	**1.69**
Shipbuilding and repairing	0.1	0.2	20.5	0.37	0.65
Rubber and plastic products	0.6	1.9	25.3	0.28	0.85
Petroleum products	2.0	0.7	9.3	1.41	1.15
Non-metallic mineral products	3.1	3.1	16.9	2.22	2.75

[8] Amiti and Freund (2008) estimated that between 1992 and 2005, there has been no change in the skill content of China's non-processing exports.

	Export share (%)		Growth rate (%)	RCA index	
	1992	2007	1992-2007	1997	2007
Metal products	6.1	17.2	24.8	0.78	1.84
Low technology	**48.5**	**38.2**	**15.3**	**2.24**	**2.51**
Manufacturing	2.8	5.7	22.3	0.88	2.08
Paper and paper products	2.7	2.2	15.7	0.78	0.94
Printing and publishing	0.2	0.2	17.1	0.27	0.63
Food, beverages and tobacco	9.7	3.1	8.9	1.62	0.68
Textiles, apparel and leather	33.2	27.0	15.5	3.98	5.06
Other	**27.5**	**9.2**	**9.3**	1.23	0.35
Total	**100.0**	**100.0**	**84.0**	**1.00**	**1.00**

Source: Authors' calculations, using China's Customs Statistics data.

This empirical finding has been confirmed by Van Assche and Gangnes (2010), who have relied on electronics production data compiled by Reed Electronics Research rather than international trade data to measure the degree of sophistication of China's production activities. The data set provides for 51 countries the value of domestic electronics production for 13 electronics subcategories between 1992 and 2005.[9] While this data set has the limit that it focuses solely on electronics, it has the benefit that it circumvents the problem with trade data by capturing the type and magnitude of production activities that take place in a country. Van Assche and Gangnes (2010) find that when the same methodology as Rodrik (2006) and Hausmann, Hwang and Rodrik (2007) is used on the electronics production data set, there is no evidence that China has production activities similar to that of much richer countries.

In sum, once China's role in global production networks is taken into account, there is little evidence that China is rapidly moving up the technology ladder and becoming competitive in technology-intensive areas where advanced economies such as Canada should have a comparative advantage.[10] Rather, China's production activities have remained consistent with its comparative advantage in labor-intensive production activities (Lin and Wang, 2008).

This of course does not mean that Canadian policymakers should ignore the rising sophistication of China's exports. Indeed, if the high-technology components that are embodied into China's exports are increasingly sourced from within the East Asian region instead of from Canada, or if the global production networks that are responsible for China's high technology exports are gaining a competitive edge against the global production networks that rely on Canadian high-technology components, this should be a concern to both Canadian policymakers and Canadian high-technology businesses. But to verify if this is the case, analysis should move beyond China's exports. A deeper understanding would be needed of the structure of the global production networks that

[9] See Reed Electronics Research (2007) for a description of the data.

[10] The results of the analysis do not imply that China's production activities are not upgrading. Rather, it suggests that China's production activities are upgrading in line with its economic development.

both Canada and China are integrated into, and how they have been changing over time. This provides a rich agenda for future research.

3.2 Business Cycle Pass-Through in Global Production Networks

An in-depth understanding of China's role in global production networks is also important to comprehend the impact of the recent economic crisis on China's international trade patterns.[11] When the crisis unraveled in the second half of 2008, some China observers worried that China's export-led growth model has rendered its economy excessively dependent on the business cycles of advanced economies. Two factoids about China's exports have spurred this apprehension. First, China's export dependence had risen rapidly over the reform period, with its export-to-GDP ratio rising from 15% in 1988 to 42% in 2007. This figure is much higher than for other large economies such as the United States, European Union and Japan which in 2007 had export-to-GDP ratios of 12%, 12% and 18% respectively.

Second, the composition of China's exports has rapidly shifted towards high ticket-item durables such as electronics (see section 2.1). These exports are more sensitive to foreign business cycles since, in times of recession, households and companies in advanced economies tend to hold off first and foremost their purchases of durable goods, and especially larger ticket-item goods including electronics products. This not only reflects the fact that tightening budget constraints in times of crisis render high ticket-item goods unaffordable for some, but also that consumers and firms in such uncertain times want to wait with their purchases of long-lasting goods until it is known with more certainty whether and when the economic climate will improve. A recent study by Engel and Wang (2008) indeed finds that U.S. durable goods imports are more sensitive to business cycles than nondurable goods imports. Furthermore, Aziz and Li (2008) demonstrate that China's increasing specialization in electronics exports has led to an overall rise in the income elasticity of China's exports.

In the first quarter of 2009, demand for China's exports indeed experienced a stunning contraction of 20.0% compared to the previous year, from US$304 billion to US$243 billion (see Table 9). As predicted, the drop in exports was primarily driven by a contraction of higher technology exports. In the first quarter of 2009, China's high technology exports were down 24.1% compared to the same quarter of the previous year, whereas medium-high technology exports, medium-low technology exports and low technology exports were down 22.0%, 21.5% and 8.9% respectively.

Despite the sharp decline in exports, China's economy escaped the crisis relatively unscathed. In the first and second quarter of 2009, China's GDP has expanded at an annualized rate of 6.1% and 7.9%, respectively. This resilience of China's economy is generally attributed to its government's massive economic stimulus package and its banking sector's aggressive credit expansion. An additional explanation, however, is that China's integration into global production networks has allowed it to rapidly pass on the negative export demand shock to its input suppliers through a reduction in demand for processing inputs. This business-cycle pass-through effect implies that the sharp export declines should not have a big effect on China's overall economic performance.

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[11] See also Ma and Van Assche (2009a, 2009b).

Table 9: China's Exports in Crisis, by Technology Level

	Total Exports (US$ billion) 08Q1	Total Exports (US$ billion) 09Q1	Total export growth (%) 08Q1/09Q1	Processing export growth (%) 08Q1/09Q1	Non-processing export growth (%) 08Q1/09Q1
High technology	**94.6**	**71.8**	**-24.1**	**-26.9**	**-11.2**
Aircraft	0.5	0.4	-20.0	8.6	-48.1
Pharmaceuticals	2.6	2.6	0.0	-3.3	3.6
Office and computing machinery	32.1	25.4	-20.9	-22.4	17.0
Radio, TV and comm. Equipment	48.1	35.7	-25.8	-27.7	-18.0
Medical, precision and optical ins.	11.4	7.6	-33.3	-40.9	-9.5
Medium-high technology	**70.0**	**54.6**	**-17.4**	**-26.9**	**-17.4**
Electrical machinery	19.4	15.3	-11.1	-29.4	-11.1
Motor vehicles	8.6	4.7	-36.2	-59.4	-36.2
Chemicals	4.7	4.0	-11.9	-18.4	-11.9
Other transport equipment	2.8	2.2	-24.1	-9.5	-24.1
Machinery and equipment	34.5	28.3	-15.1	-21.0	-15.1
Medium-low technology	**44.9**	**35.2**	**-28.0**	**-5.1**	**-28.0**
Shipbuilding and repairing	3.9	5.9	5.4	57.5	5.4
Rubber and plastic products	7.2	6.2	-1.9	-21.5	-1.9
Petroleum products	1.5	0.4	-77.3	-14.7	-77.3
Non-metallic mineral products	5.1	4.5	-8.7	-31.1	-8.7
Metal products	27.2	18.3	-32.6	-34.3	-32.6
Low technology	**73.8**	**67.2**	**-6.4**	**-14.6**	**-6.4**
Manufacturing	17.1	15.4	-3.6	-16.9	-3.6
Paper and paper products	4.1	3.2	-19.5	-29.0	-19.5
Printing and publishing	0.6	0.6	6.7	-1.3	6.7
Food, beverages and tobacco	4.4	5.0	-12.8	2.5	-12.8
Textiles, apparel and leather	46.4	43.0	-5.4	-13.5	-5.4
Other	**20.5**	**14.4**	**-29.9**	**-42.3**	**-26.4**
Total	**303.8**	**243.2**	**-20.0**	**-23.7**	**-16.2**

Source: Authors' calculations using China's Customs Statistics

There are a number of indications that such a business cycle pass-through effect indeed took place in the realm of the recent economic crisis. First, when the crisis hit, the drop in China's exports was especially pronounced for processing exports, with processing exports contracting 23.7% and non-processing exports declining 16.2% (see the right-

hand panel of Table 9). Except for some smaller industries, this tendency was uniform across sectors.

Table 10: China's Imports in Crisis, by Technology Level

	Total Imports (US$ billion)		Total imports growth (%)	Processing Imports growth (%)	Non-processing imports growth (%)
	08Q1	09Q1	08Q1/09Q1	08Q1/09Q1	
High technology	**77.2**	**54.9**	**-28.8**	**-36.6**	**-17.4**
Aircraft	2.3	2.5	9.5	-17.8	10.9
Pharmaceuticals	1.4	1.7	23.0	24.0	23.4
Office and computing machinery	9.1	6.6	-28.0	-32.5	-25.1
Radio, TV and comm. Equipment	44.6	32.4	-27.5	-31.9	-18.7
Medical, precision and optical ins.	19.8	11.8	-40.4	-49.8	-24.5
Medium-high technology	**48.7**	**37.5**	**-23.0**	**-27.9**	**-21.0**
Electrical machinery	11.8	9.0	-23.4	-30.7	-14.9
Motor vehicles	7.2	5.1	-30.0	-35.0	-29.9
Chemicals	5.4	4.0	-26.8	-32.9	-22.8
Other transport equipment	0.4	0.5	18.7	-13.1	27.0
Machinery and equipment	23.8	18.9	-20.5	-22.0	-20.1
Medium-low technology	**27.4**	**20.2**	**-26.1**	**-43.8**	**-15.7**
Shipbuilding and repairing	0.3	0.3	19.8	377.6	7.7
Rubber and plastic products	3.4	2.3	-31.4	-31.5	-31.3
Petroleum products	0.9	1.0	13.3	395.9	-3.6
Non-metallic mineral products	1.3	0.8	-35.6	-44.5	-27.4
Metal products	21.5	15.8	-26.9	-48.7	-14.4
Low technology	**16.8**	**12.7**	**-24.7**	**-28.7**	**-22.0**
Manufacturing	1.3	1.1	-16.2	-27.7	0.0
Paper and paper products	4.7	3.4	-28.0	-44.0	-22.1
Printing and publishing	0.2	0.2	5.6	-13.3	18.2
Food, beverages and tobacco	5.4	3.7	-31.7	-29.5	-32.0
Textiles, apparel and leather	5.3	4.4	-17.7	-23.8	-2.6
Other	**90.9**	**54.4**	**-40.1**	**-41.8**	**-39.9**
Total	**260.9**	**179.8**	**-31.1**	**-36.2**	**-28.5**

Source: Authors' calculations using China's Customs Statistics

Second, despite relatively robust economic growth, China's imports dropped an even larger 31.1% in the first quarter of 2009 compared to a year later (see Table 10). Commodity price declines in the second half of 2008 played a role in the contraction of imports (Petri and Plummer, 2009) but, just like on the export side, the imports decline was more pronounced for processing imports than non-processing imports. Processing imports dropped by 36.2%, while non-processing imports dropped 28.5%.

The accentuated drop in processing imports is clearly demonstrated in the case of Canada. As it is shown in Table 11, in the first quarter of 2009, China's processing imports from Canada dropped 47.8% compared to a year earlier, while China's non-processing imports from Canada declined 10.9%. Furthermore, in 7 of the 21 industries, a contraction of processing imports from Canada actually went hand-in-hand with an expansion in non-processing imports from Canada.

Table 11: China's Processing Imports from Canada in Crisis, by Technology Level

	Non-processing Imports (US$ million)		Non-processing Imports growth (%)	Processing Imports (US$ million)		Processing Imports growth (%)
	08Q1	09Q1	08Q1/ 09Q1	08Q1	09Q1	08Q1/ 09Q1
High technology	**172**	**145**	**-15.7**	**158**	**105**	**-33.6**
Aircraft	64	19	-70.3	5	3	-40.2
Pharmaceuticals	9	5	-44.4	0	0	-53.8
Office and computing machinery	11	16	45.5	1	1	-17.9
Radio, TV and comm, Equipment	39	50	28.2	147	97	-34.1
Medical, precision and optical instr.	45	54	20.0	6	5	-18.3
Medium-high technology	**179**	**378**	**111.2**	**41**	**22**	**-47.1**
Electrical machinery	26	31	19.2	15	8	-49.9
Motor vehicles	32	13	-59.4	3	1	-76.3
Chemicals	10	12	20.0	7	4	-33.4
Other transport equipment	4	1	-75.0	0	0	0.0
Machinery and equipment	111	324	191.9	16	9	-44.3
Medium-low technology	**230**	**175**	**-23.9**	**130**	**35**	**-73.2**
Shipbuilding and repairing	0	0	0.0	0	0	0.0
Rubber and plastic products	8	5	-37.5	4	3	-24.4
Petroleum products	7	6	-14.3	0	0	-63.4
Non-metallic mineral products	4	3	-25.0	1	0	-28.0
Metal products	212	162	-23.6	126	32	-74.9
Low technology	**461**	**404**	**-12.4**	**139**	**66**	**-52.4**
Manufacturing	6	2	-66.7	1	1	-26.1

	Non-processing Imports (US$ million)		Non-processing Imports growth (%)	Processing Imports (US$ million)		Processing Imports growth (%)
	08Q1	09Q1	08Q1/ 09Q1	08Q1	09Q1	08Q1/ 09Q1
Paper and paper products	405	345	-14.8	113	48	-57.3
Printing and publishing	1	1	0.0	0	0	-80.7
Food, beverages and tobacco	37	35	-5.4	12	10	-14.0
Textiles, apparel and leather	17	19	11.8	12	6	-46.8
Other	**1,150**	**857**	**-25.5**	**141**	**90**	**-36.0**
Total	**2,200**	**1960**	**-10.9**	**610**	**320**	**-47.8**

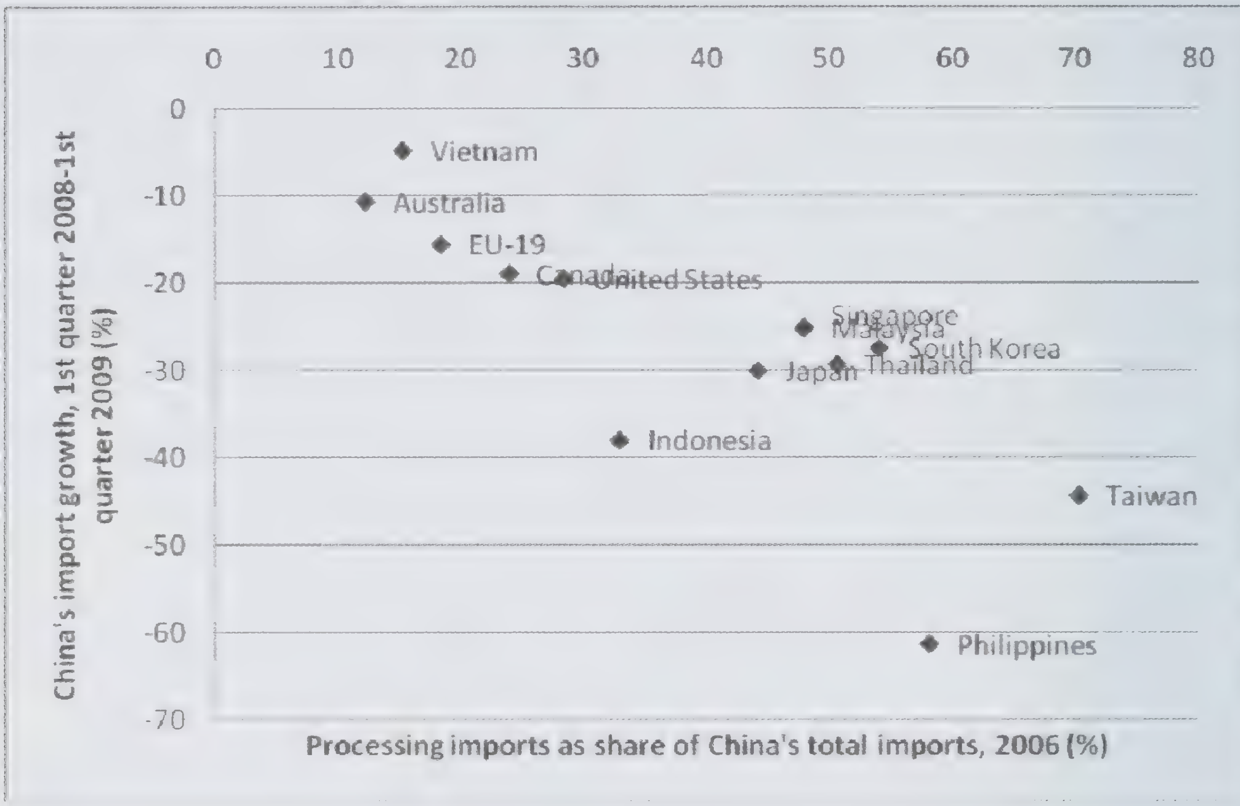
Third, the negative economic shock seems to have been amplified as it moved upstream from processing exports to processing imports. This is in line with the bullwhip effect that is often witnessed in global supply chains (Lee, Padmanabhan and Wang, 1997; Cachon, Randall and Schmidt, 2007). When a drop in final demand reduces downstream activities, a firm's first reaction is to run down its inventories. Thus a slowdown in downstream activities transforms itself into an amplified reduction in the demand for inputs that are located upstream. As it is shown in Table 8, in almost all industries, the decline in processing imports has been more pronounced than the drop in processing exports.

Fourth, the crisis has hit most severely China's imports from countries that more intensively supply China with its processing inputs, that is, its East Asian neighbors. As it is shown in Figure 9, with the exception of Vietnam and Indonesia, more than 40% of China's imports from its major East Asian trading partners were processing imports in 2006, which is a significantly higher share than for countries outside of East Asia. These East Asian countries have witnessed the largest import decline in the realm of the recent global economic crisis. Compared to the previous year, China's imports from its major East Asian trading partners have all declined between 25% and 61% in the first quarter of 2009. In contrast, China's imports from its major non-Asian trading partners have dropped less than 20%.

In sum, due to China's heavy integration into global production networks, its economy was less vulnerable to the recent economic crisis than it was generally feared. China effectively transferred a large portion of its negative export demand shocks to its input suppliers by reducing its demand for processing imports. This business-cycle pass-through effect implied that the large brunt of the burden of China's export decline fell upon its East Asian neighbors.

For policymakers, the empirical findings provide new evidence that business cycle shocks are rapidly transmitted internationally through global production networks (Burstein, Kurz and Tesar, 2008). This business cycle pass-through effect helps explain the large drop in world trade that was registered in the realm of the recent global economic crisis (Tanaka, 2009; Yi, 2009; Escaith, 2009).

Figure 10: Intensity of China's processing imports (2007) versus severity of China's imports contraction (08Q1-09Q1), by country of origin.



Source: Authors' calculations using China's Customs Statistics.

4. Concluding Remarks

Over the past few decades, many multinational firms have integrated China into their global production networks by moving labor-intensive processing plants to the country for export purposes. It is often neglected, however, that these processing plants heavily rely on imported inputs for their exports, while only a relatively small portion of the export value is produced in China. In the media and even in academic and policy circles, this has led to important misinterpretations of China's role in the world economy.

The goal of this paper has been two-fold. First, we have conducted an anatomy of China's processing trade to get a deeper understanding of China's role in global production networks. Second, we have used these insights to revise downward the speed of China's technological upgrading trajectory, and to explain the relatively limited impact that the sharp drop in exports had on China's economic performance during the recent global economic crisis.

More generally, our paper has illustrated that the growing role of global production networks in international trade presents researchers and policymakers with a new set of challenges. The assumption that a country's exports are entirely produced domestically has been inaccurate for some time. But, to date, little research has been conducted to comprehend the sometimes significant biases that this assumption may create. With our analysis, we hope to have convinced the reader that more granular, empirical research is needed to analyze the structure of global production networks, the role that Canada plays in these global production networks, and the implications that it has on policy formulation.

In recent years, Canadian government agencies and government-related think tanks have taken a number of initiatives to improve our understanding of global production

networks. In 2006-2007, Industry Canada organized two international conferences to understand the impact of "global value chains" on industries and the economy, as well as to clarify the role of governments in facilitating competitiveness in a world where global production networks are prevalent. Furthermore, in 2007, the Conference Board of Canada and the Department of Foreign Affairs and International Trade (DFAIT) published special policy pieces on Canada's role in global value chains (Goldfarb and Beckman, 2007; Sabuhoro and Sydor, 2007). In the future, more research is needed in this direction.

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Global Value Chains in Canada

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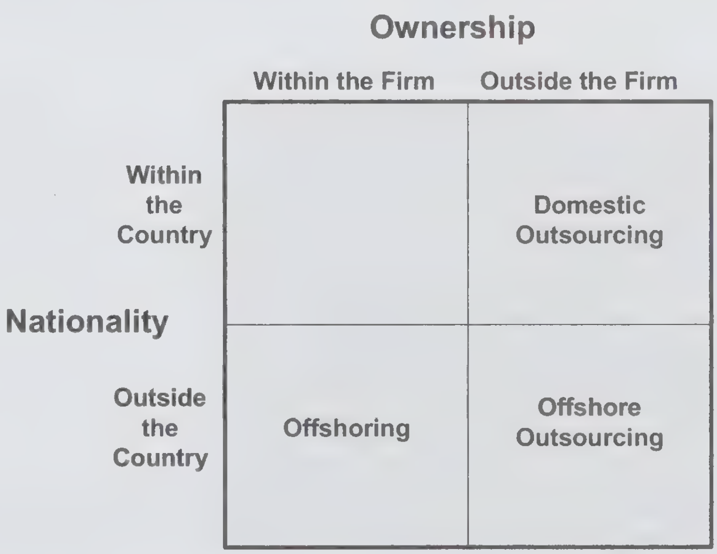
Introduction

Intuitively, the idea of global value chains (GVCs) is relatively easy to understand - making a product or delivering a service involves many steps and increasingly these steps are separable and can be located anywhere in the world based on where it is most efficient to perform. Formalizing this simple concept, however, is much more challenging and developing measures has proven even more difficult. In this chapter, we analyze and explore data coming out of the recently completed Survey of Innovation and Business Strategies (SIBS) with a view to better understanding how Canadian companies are engaged in GVCs and the barriers that they face when in participating in GVCs. We also, to the extent that it is possible, compare the results for Canada to those from the EU as well as attempt to call on other sources of data to provide a better understanding of global value chains in Canada.

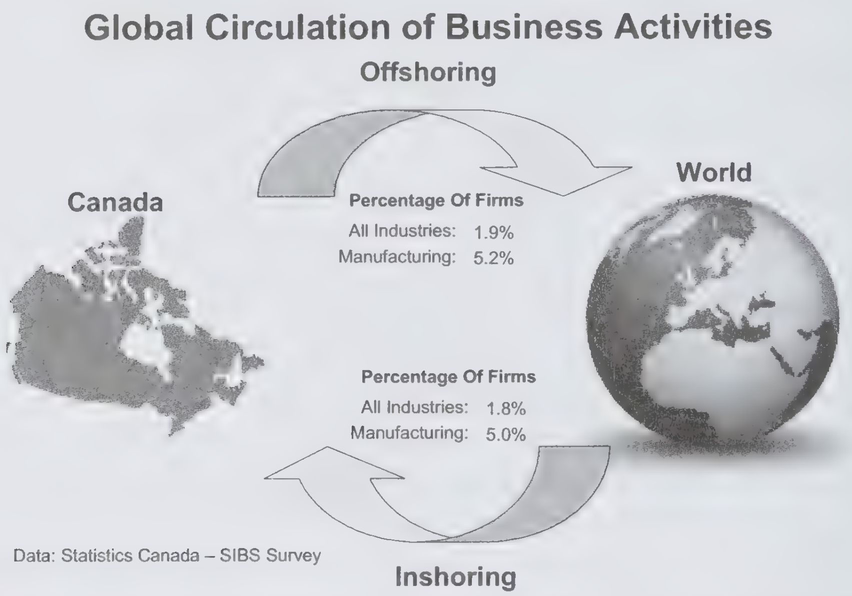
Trends in Offshoring and Outsourcing in Canada

The concepts of offshoring and outsourcing are intimately related to GVCs. If "global value chain" is the noun that describes how activities are organized globally, offshoring and outsourcing are the verbs that describe the movement of activities in and out of the country. Offshoring is essentially the movement of an activity outside of the country but the activity continues to be performed within the ownership structure of the firm. For example, a manufacturer located in Canada who opens an assembly plant in a foreign country would be considered to be offshoring the activity of goods production. Inshoring is the opposite of offshoring in that the activity that was once performed in a foreign location is moved into Canada. In contrast, outsourcing implies that that the activity is now being purchased from a supplier external to the firm. For example, a company located in Canada contracts a firm to supply it call center services from a foreign location, in this example, it would be outsourcing of call center services. While outsourcing does not necessarily require the source to be foreign, in our analysis, outsourcing will be synonymous with foreign outsourcing (sometimes referred to as offshore outsourcing).

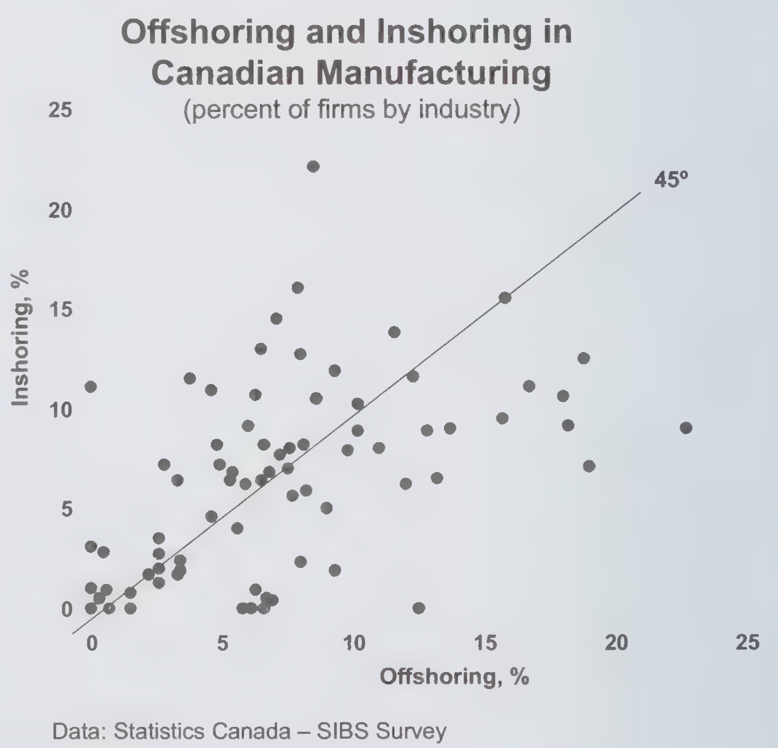


Like offshoring, outsourcing has an opposite in the form of insourcing, when a foreign supplier is replaced by a domestic one.

Although there has been a great deal of attention given to offshoring and outsourcing in the media and in policy circles, it turns out that both of these trends are fairly rare. Possibly even more importantly, the trends appear to be much more circular than is commonly though; a roughly similar number of activities appear to be moving into Canada as out.



For companies located in Canada (including foreign companies located in Canada)[1], between 2007 and 2009, only 1.9 percent of companies offshored a business activity. For manufacturing the rate was more than twice as high but still only 5.2 percent. What may be more striking though is that the movement is much more of a circular movement rather than a one-way outflow. A nearly equal number of firms moved activities into Canada as moved activities out; 1.8 percent of firms overall and 5.0 percent of manufacturers "inshored" activities. Unfortunately the data does not allow us to know the actual value of what was offshored or inshored or the employment associated with those movements and



[1] Throughout this analysis, we will often refer to "all industries" for simplicity. The SIBS survey, however, excludes a number of industries, mostly (although not exclusively) those with a high share of public sector involvement such as public administration, education and healthcare. For more details on the industries covered in the SIBS survey, please refer to Annex 1.

therefore we cannot know to what extent the scale of one is greater or less than the other, but we are clearly left with a picture of a small number of firms moving activities, and are nearly as likely to be moving activities into Canada as out. The scale of activities being moved in terms of their value or employment is an important missing element of this picture as there is a considerable difference in these trends by size of firms. 10.9 percent of large firms, for example, offshored some activities while only 2.4 percent of medium and 1.2 percent of small firms did so.

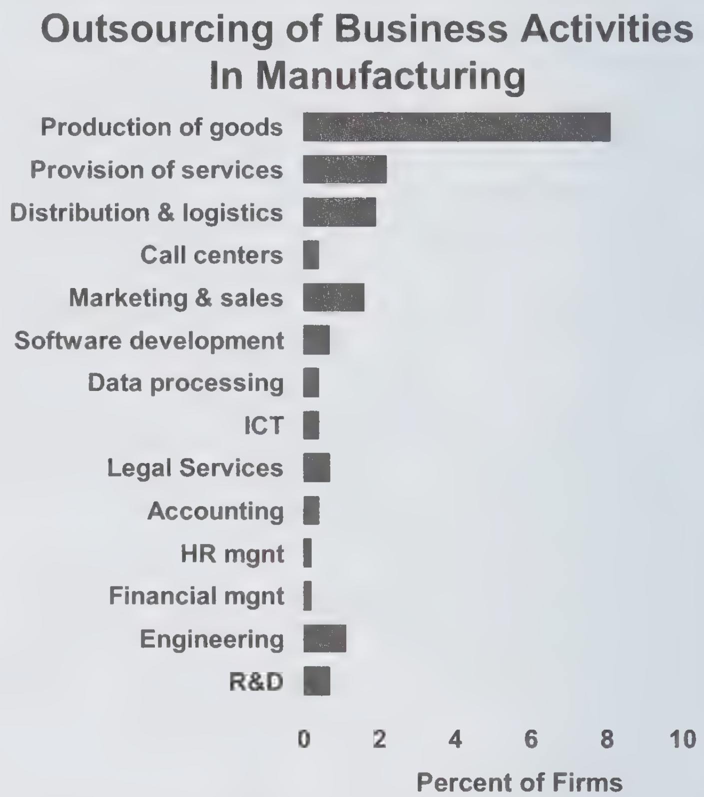
In terms of industries, there is a high degree of correlation between offshoring and inshoring. This suggests that some industries are simply more footloose than others and as a result are more likely to move activities both out of Canada as well as into Canada. Within the manufacturing sector, these industries include those producing electronics and related products such as household appliance manufacturing industry, telephone apparatus manufacturing and radio and television broadcasting equipment, but also includes transportation equipment manufacturing, and some specialized machinery manufacturing.

The number of industries for which there is net offshoring (percent of firms indicating that they offshore is greater than the number who inshore) only slightly outweighs the number of industries for which there is net inshoring. Within manufacturing the number of firms moving activities into Canada is greater than those moving activities out of Canada in motor vehicle manufacturing, broadcasting equipment manufacturing, communications equipment manufacturing, pharmaceutical manufacturing as well as a number of resource processing sectors. The reverse is true (net offshoring) mainly in electronics producing industries. Again, caution must be used in interpreting the figures as they indicate only the percentage of firms performing the activity and not the scale.

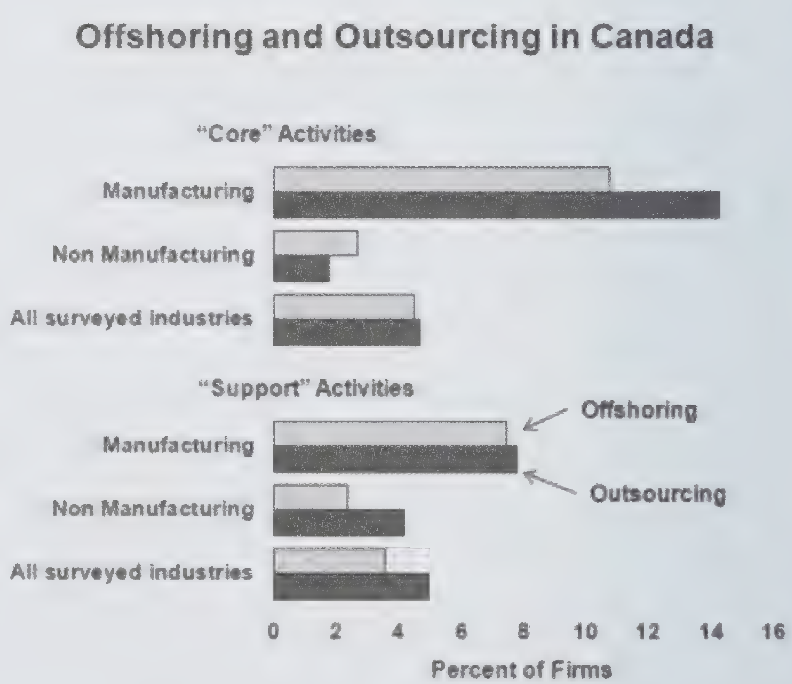
As already noted, larger firms, with their greater experience in operating globally, are far more likely to move activities…both in and out of Canada. From 2007 to 2009, 17.6 percent of large manufacturing firms relocated activities out of Canada while 12.1 percent moved activities into Canada compared to only 3.1 percent and 3.5 percent respectively for small firms. These figures also highlight the importance of scale. While large firms were much more likely to offshore activities compared to inshoring activities (17.6% compared to 12.1%), small firms were more likely to do the reverse (3.1% for offshoring compared to 3.5% for inshoring). In terms of numbers, small firms carry significant weight, but likely much less so when values or employment are considered.

A key aspect in the conceptual framework of global value chains is the idea of <u>activities</u>. While we traditionally talk about industries (such as the electronics industry) or even firms within an industry, each industry or firm undertakes a series of similar activities. For example, most firms will need to worry about financing, human resource management (HR), information and technology management, legal issues and so on. For some firms, and especially the larger ones, these will be handled more formally with a specific person designated to deal with those issues, or for the largest firms, they could have entire divisions to handle such activities. For smaller firms, the owner or manager may handle many, if not all, of those activities. Within a global value chains framework, what becomes important is whether the firm performs these activities within the firm and within the home country, or if they are undertaken outside of the home country (offshored) or outside the firm (outsourced). One might also ask why different firms organize themselves in different ways and how this contributes to their competitiveness and productivity. The Survey of Innovation and Business Strategy (SIBS) identifies fourteen business activities that are thought to be integral to the operation of most firms and are key to understanding offshoring and outsourcing.

Of the fourteen activities identified in the survey, two could be considered "core" in that they are the primary activity of the firm which are the production of goods for goods producing industries and the provision of services for service industries. This is in contrast to other activities which could be considered "support" activities in that most firms would perform these activities, but they are not the primary activities of the firm. These include such as activities and human resource management (HR), accounting and IT support.[2] Overall, there is not a large difference for offshoring and outsourcing between core and support activities. There is a modest preference in favour of outsourcing support activities compared to offshoring which is not unexpected given that firms could more easily contract out these types of activities. Manufacturers are much more involved in offshoring and outsourcing than are other industries which may stem from a higher level of competition in these highly tradable industries forcing them to look for any cost advantage possible. It is also notable that manufacturers more actively offshore and outsource core activities and in particular the production of goods. This may, in fact, suggest that the idea of core and support activities does not fit with the reality. Manufacturers may, for example, believe that research and development, marketing

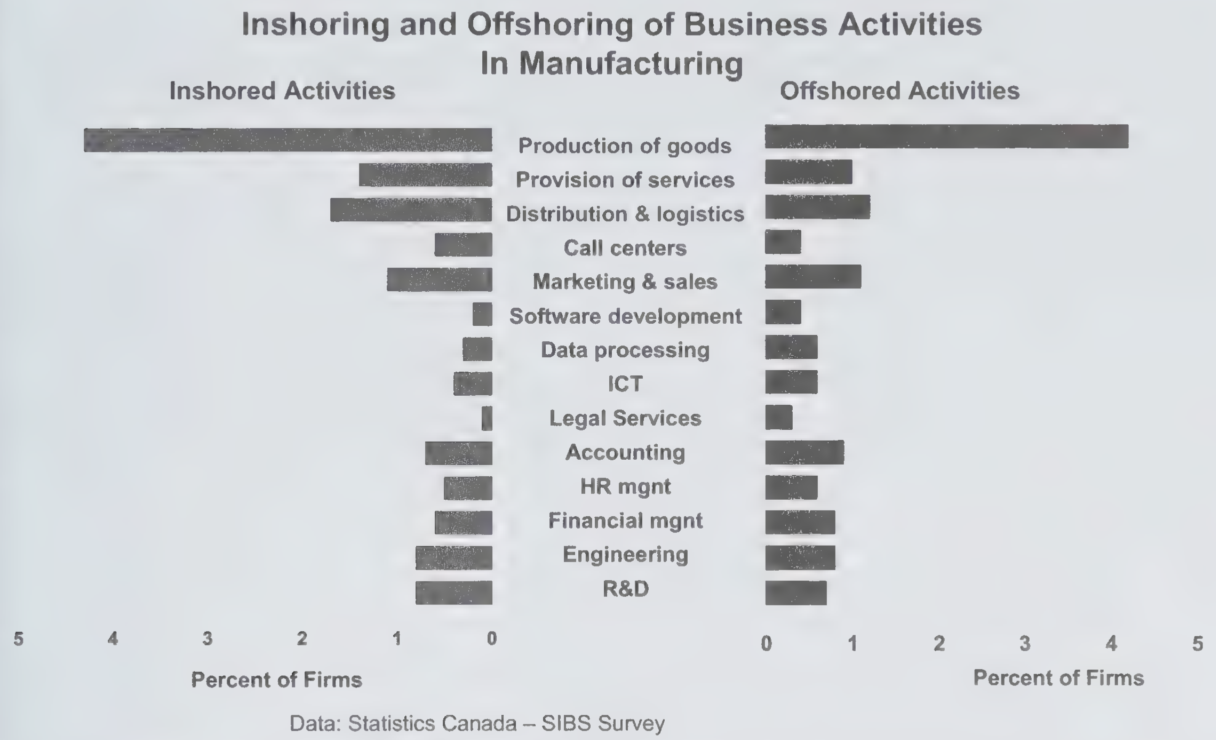


Data: Statistics Canada – SIBS Survey



Data Statistics Canada – SIBS Survey

[2] The concept of "core" and "support" activities is taken from the EuroStat survey on offshoring and outsourcing.



or brand management are much more their core activities rather than actual production.[3]

Looking at the fourteen activities covered in the survey in more detail, the most footloose activity (the activity most likely to be offshored or inshored) by manufacturers, as already noted, is the production of goods. In terms of offshoring, the production of goods was nearly four times as likely to be offshored as the next most footloose activity; distribution and logistics. For inshoring, it was about three times, based on the number of firms offshoring or inshoring that activity. Thus, here too the data sheds light on the debate in the media and policy circles; despite the focus on the increased tradability of services, it is the production of goods that remains the most internationally mobile activity - and by a wide margin. Additionally, and based on the number of firms, there is a tendency towards net inshoring with 4.3 percent of manufacturing firms inshoring the production of goods compared to 4.2 percent offshoring.

Other activities demonstrating a tendency for net inshoring are service provision as well as distribution and logistics, call centers, and R&D. Data processing, ICT, Legal and Accounting, are among those with net outward movements.

Outsourcing involves buying a good or service from abroad at arm's length (not produced within the ownership structure of the firm) and generally under a contract. Not surprisingly, this is far more common than offshoring as it does not involve equity ownership of operations abroad. Overall, 4.1 percent of firms outsourced between 2007 and 2009, but the share was much higher for manufacturers, of which 10.1 percent outsourced over that period. Nearly double the share of firms which offshored over the same period.

Like offshoring, by far the most common activity to outsource by manufacturing firms was the production of goods. This was followed by the provision of services, distribution & logistics, and marketing & sales.

By comparing the trends in offshoring and outsourcing these results also reveal information about the types of activities that manufacturers tend to like to do themselves

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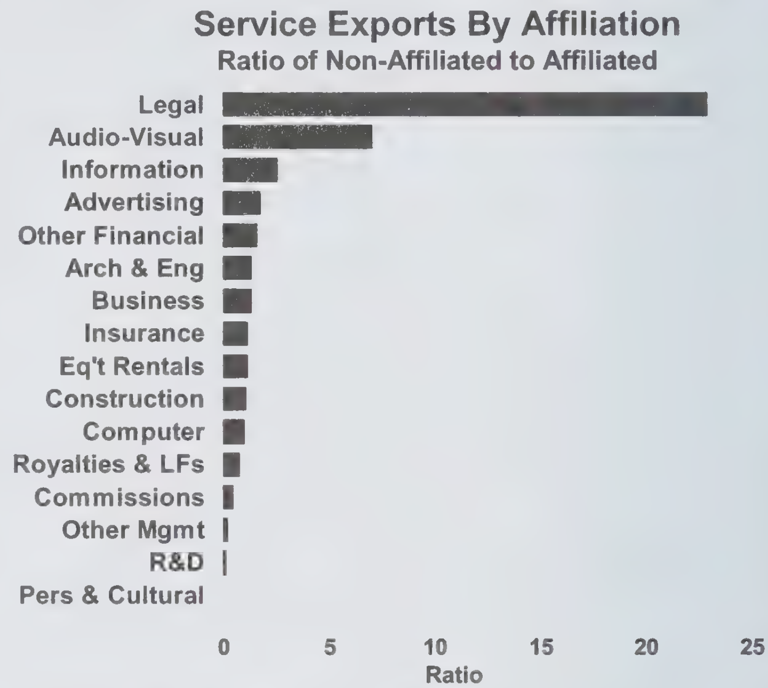
[3] This would appear to be the case for Apple, which contracts out most of its production but the well-studied examples of the ipod and iphone demonstrate that most of the value of these products comes from innovation, design and marketing.

abroad and those that they are willing to buy at arms length. For manufacturers, legal services are far more likely to be purchased at arm's length. This is a reassuring result given the known preference for frequently hiring outside legal council, particularly in foreign markets. There is also a strong preference for contracting the provision of services, production of goods, distribution & logistics, and marketing & sales. Alternatively, companies are more likely to keep financial management, HR and accounting internal.

This overall trend can be confirmed through alternative data sources. Canada is one of the few countries that collects data on services trade by affiliation; whether the services trade occurs between parties that are wholly or partially owned by a common parent. It is doubly useful in that it measures the value of transactions rather than the number of firms, as is the case with the SIBS data. Taking the ratio of the value of non-affiliated to affiliated trade reveals a strikingly similar pattern to the SIBS data. For those service activities that have similar definitions between the two sources, legal services stands out as being dominated by arms-length transactions, as does advertising services. On the other hand, other management services, which would include accounting and HR services, stands out as being done largely within the structure of the firm; that is more affiliated trade than non-affiliated trade. While the chart depicts only service exports, the trend is nearly identical for service imports with a correlation coefficient of 0.977 between the ratios for the two.



Data: Statistics Canada, data for 2008

Firms which either outsourced or offshored activities indicated that by far the most important reason for doing so was cost. Reduction of non-labour costs was indicated as the most important factor while reduction of labour costs, was ranked second. This was also the case for manufacturers and non-manufacturers alike. Although substantially less important than costs, manufacturers cited access to new markets as the third most important factor while non-manufacturers chose access to specialized knowledge and technologies as third. Both groups indicated that lack of available labour and tax or other financial incentives were not particularly important factors. This paints a fairly clear picture of the drivers of outsourcing. These results clearly show that, and as one might expect, the most important factor driving firms to outsource is indeed costs. This also supports the view that it is predominantly pull factors that drive offshoring and outsourcing; the emergence of large supplies of low cost labour as well as large and growing markets that are driving offshoring and outsourcing, rather than push factors that make Canada an unappealing location from which to do business. Again, this would be consistent with the earlier findings that these movements are a circular flow and not a one-way exodus.

Top Obstacles when Offshoring or Outsourcing*

Obstacle	% of Firms
Distance to producers	55.5
Identifying providers	54.9
Language or cultural	45.1
Tariffs	43.9
Foreign legal or admin	41.3
Lack of mgmt expertise	37.4
Cnd Legal or Admin.	33.4
Distance to customers	32.7
Concerns of employees	32.0
Lack of financing	30.5
Tax	25.0
International standards	24.5
Social Values	20.4
IP	8.3

•Those indicating medium or high motivation manufacturers
Data: Statistics Canada – SIBS Survey

When conducting offshoring our outsourcing roughly one-fifth of firms indicate that they encountered obstacles in doing so. Interestingly, the proportion was about the same for small firms compared to the average. For respondents overall, foreign legal or administrative obstacles were identified as being the most significant obstacle followed by language or cultural barriers and distance to producers. For manufacturers (shown) the priorities were somewhat different. Distance to producers was identified as the most important barrier followed by difficulties in identifying potential or suitable providers and language or cultural barriers.[4] For both groups, sourcing providers and dealing language and cultural issues and foreign legal or administrative issues were identified as being significant which supports the role of the Canadian trade commissioner service (TCS) in overcoming obstacles such as these. Tariffs also rank among the top for manufacturing firms suggesting the need for continued tariff reductions. Interestingly, concerns about conflicting with social values, concerns of employees and IP concerns were all identified as least important for both groups which may point to the ability of firms to address those issues themselves.

It is important to note, however, that these aggregate results disguise more specific results. Even though concerns with intellectual property (IP)

Top Motivations for Offshoring or Outsourcing*

Motivation	% of Firms
Non-Labour Costs	69.4
Labour Costs	67.3
Access to Knowledge	43.9
New goods or services	41.5
Access to New Markets	37.8
Focus on Core Business	37.7
Delivery Times	34.3
Logistics	26.5
Following comp or clients	24.9
Lack of Labour	24.6
Tax or Financial	18.1
Other	5

* Those indicating medium or high motivation
Data: Statistics Canada – SIBS Survey

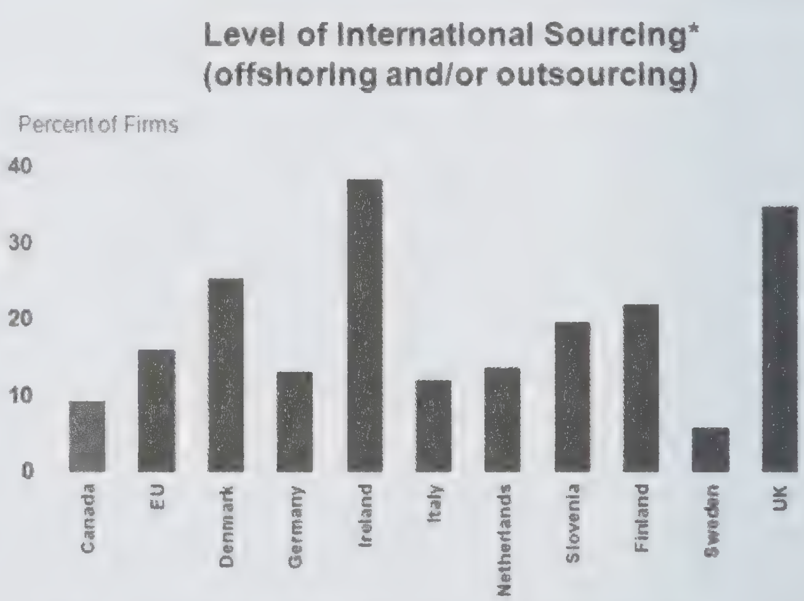
[4] These indications of obstacles are based on combining high and medium responses. There are some instances, however, where a response was marked high for a significant share of respondents without a correspondingly large medium share which lowers the overall score for that response. Specifically, for all industries, Canadian legal or administrative barriers would be ranked first based on high responses alone, while tariffs would have been ranked second for manufacturers. This may indicate that while these obstacles were not as wide spread, for the firms that faced them, they were extremely important.

is listed last, this was an important concern for a number of R&D intensive industries such as Aerospace and information and communications technologies. Similarly, it must be remembered that the single most important destination for offshoring and outsourcing by companies in Canada is the U.S. which would be expected to pose very different obstacles compared to low-wage destinations.

Offshoring and Outsourcing in Europe

Eurostat, the statistical agency of the European Union, was the first statistical organization to design an economy-wide survey of offshoring and outsourcing. The survey was then implemented on a voluntary basis in 13 European countries. The Eurostat survey served as an important model for the design of the global value chains portion of the SIBS survey undertaken in Canada. It is important to note when comparing results, however, that there are also a number of differences between the two surveys. The Eurostat survey, for example, covers only enterprises with more than 100 employees while the SIBS survey normally covers enterprises with more than 20 employees, although for the following comparisons, the SIBS data was modified to conform to the Eurostat standard. The Eurostat survey covers most of the economy excluding only the financial sector while the SIBS survey also excludes a number of sectors with high levels of public sector involvement such as education, healthcare and public administration as well as travel, tourism and cultural industries. Finally, the Eurostat survey asks about offshoring and outsourcing trends between 2001 and 2006, for the SIBS survey the point of reference is from 2007 to 2009.[5][6]

Overall, companies in Canada appear to be somewhat less engaged in international sourcing than companies in the EU and far below that of Ireland, the UK and Denmark. One would expect there to be a correlation between the level of offshoring and outsourcing and the size of an economy. Larger countries can source a greater share of inputs from domestic markets and thus would be expected to participate less in global sourcing, all else being equal, just as larger countries tend to have a lower trade to GDP ratio. The data supports this to an extent; Italy and Germany both have relatively low levels of



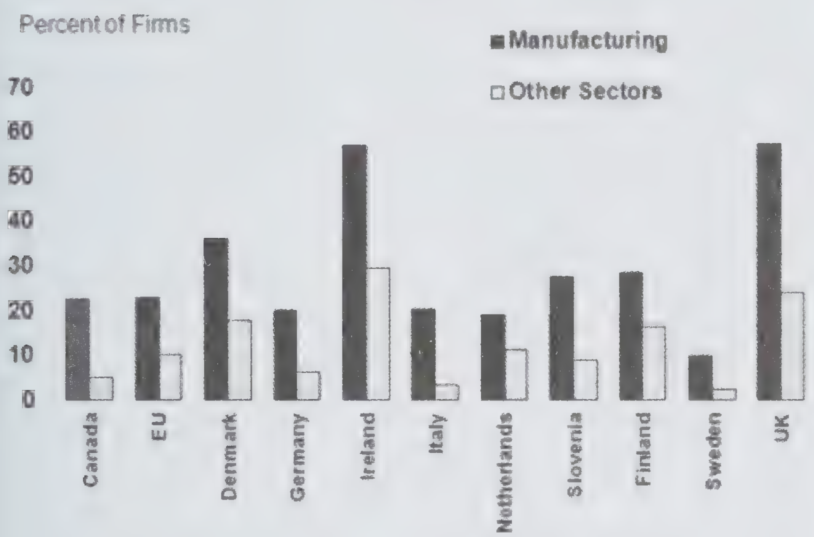
* 100 or more employees 2007-2009 for Canada 2000-2006 for EU
Data: Statistics Canada, Eurostat

[5] For a more thorough discussion of the global value chains portion of the SIBS survey, please refer to Annex 1. For more information on the Eurostat survey, refer to "International Sourcing in Europe" by Pekka ALAJÄÄSKÖ.

[6] Note that all estimates for the EU as a whole that are reported in this section are estimates based on those EU members which participated in the survey.

international sourcing compared to other EU countries, while the small countries tend to have higher levels. There are a few notable exceptions to this, however, such as Sweden and to a lesser extent the Netherlands, which one might expect to have higher levels of international sourcing, while Ireland, and especially the UK given its domestic size, show very high levels of international sourcing. Language may account for some of these differences, as smaller countries with non-widely spoken languages may face a natural barrier to offshoring and outsourcing while the opposite may be true for widely spoken languages and English in particular. Differences in industrial structures may also account for some of the difference. Still, given its size, Canada stands out as participating less in international sourcing.

Level of International Sourcing by Sector*



* 100 or more employees, 2007-2009 for Canada, 2000-2006 for EU
Data: Statistics Canada, Eurostat

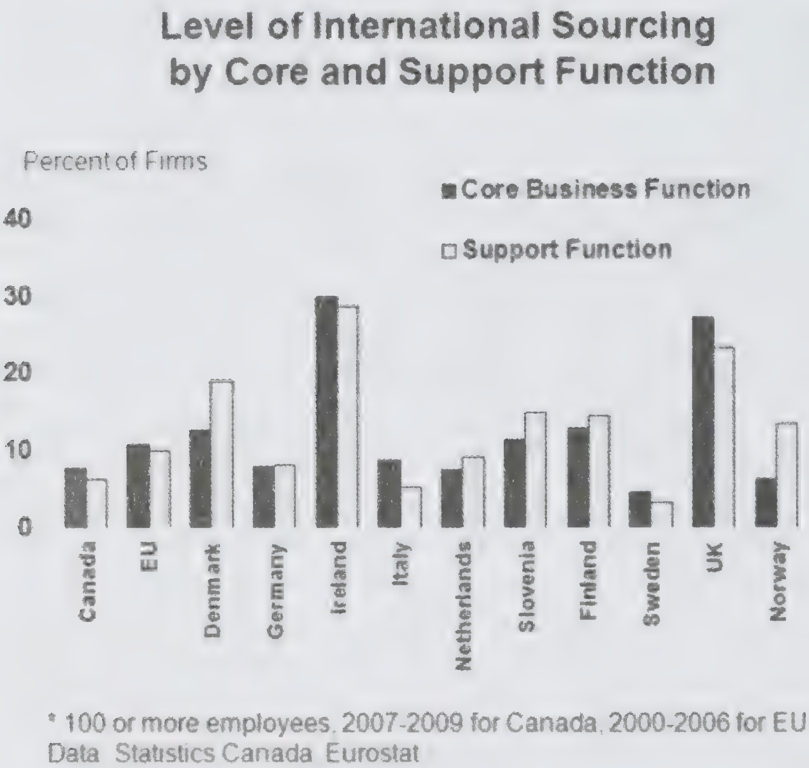
International Sourcing in Manufacturing*

* 100 or more employees, 2007-2009 for Canada, 2000-2006 for EU
Data: Statistics Canada, Eurostat

Part of the explanation for this result, however, is less participation in international sourcing outside of manufacturing. Manufacturers in Canada appear to be just as engaged in international sourcing as their EU-based counterparts. But, outside of manufacturing Canada has among the lowest rate, less than only Italy and Sweden and only about half the level of the EU average. For manufacturing, but especially for non-manufacturing sectors Ireland and the UK stand out for their particularly high levels of international sourcing. It is important to remember that there were important differences in the sectors covered by the two surveys, especially outside of manufacturing, and also different time-frames. But it is not clear how these differences would result in such a low rate of international sourcing for Canada compared to EU levels. A notable

similarity between the Canadian case and that of the EU is that for both, the top partner for international sourcing is not low-wage countries but a close-by and rich partner; for Canada this was the U.S. while for European respondents it was other EU countries.

Another notable trend is that continental EU countries, for whom data exists, with the exception of Denmark, demonstrate a notable preference for offshoring compared to outsourcing. The reverse is true, however, for Canada and for the UK. For Ireland the two are even. It may be that Anglo-Saxon managers are more disposed to offshoring and outsourcing in general and between the two have a preference for outsourcing. It may also be possible that Anglo-Saxon countries are generally more open to trade, but either of these two hypotheses would need to be confirmed with more rigorous analysis.



Looking once again at all sectors, but seperating international sourcing into the type of activity being sourced, Canadian-based companies show a small preference for internationally sourcing "core business functions". The EuroStat survey defines the production of goods and the provision of services as core business functions while all others, such as HR, Accounting and Finance are considered support functions. Both the UK and Ireland also demonstrate a modest preference for the international sourcing of core functions as do Italy and Sweden which contribute to the EU overall having a slight prefence in that direction while the opposite is true for all of the other countries for which there is data. Much more work needs to be done to understand why this may be the case. Also, the Eurostat grouping of "core" and "support"activities may be misleading as they are clearly dependent on the sector; production of goods may be core for the manufacturing sector, but not for others while HR services may be considered core for HR firms, and as previously noted, production of goods may no longer even be considered a core activitiy for manufacturing firms.

Within the category of support functions, levels of sourcing for individual activities are highly correlated to overall sourcing levels, but there are important differences between countries. 8.2 percent of Germany firms internationally sourced support functions, for example, but only just over one-quarter of those sourced distribution and logistics. By contrast, more than half of Irish firms sourced distribution and logistics and nearly 60 percent of UK-based firms did. This, may sugest that german firms consider distribution and logistics a key component of firm competitiveness, and thus too important to source. An interesting possibility since German firms tend to be heavily concentrated in manufacturing and Germany is often held up as an example for the efficiency of its logistics system. On the other hand, roughly one-third of firms engaged in sourcing, sourced marketing and sales in both Germany and the UK, while nearly half did so in Italy

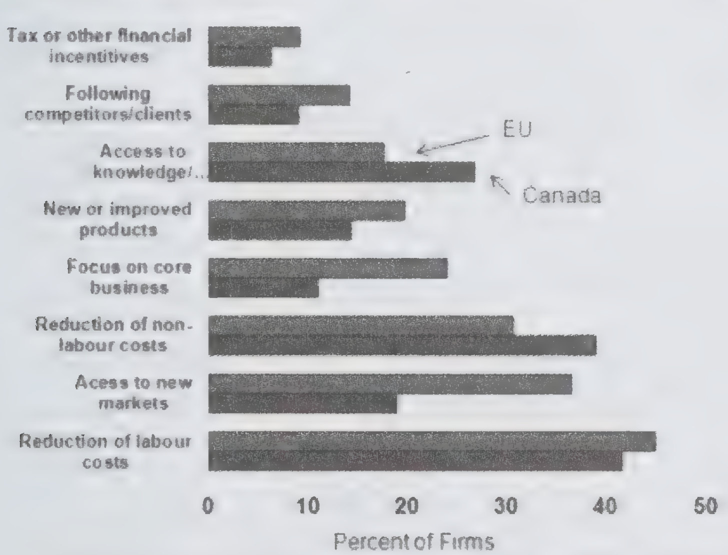
Share of Enterprises Carrying Out International Sourcing by Type of Support Activity*

	Overall Sourcing of Support Functions	Distrabution and Logistics	Marketing Sales and After Sales Services	ICT Services	Administrative and Management	Engineering and Related Technical Services	Research and Development
Canada	6.3	1.4	1.2	2.4	1.8	1.5	1.0
EU	10	4.3	3.7	2.8	2.9	2.9	2.1
Denmark	19	6.0	4.3	7.5	4.8	5.8	4.3
Germany	8.2	2.3	3.1	0.8	1.4	2.3	1.2
Ireland	20.7	15.9	13.3	10.9	8.2	13.0	6.2
Italy	5.3	2.0	2.6	1.3	1.8	0.9	1.0
Netherlands	9.1	3.1	1.7	3.6	3.1	0.6	1.8
Slovenia	14.9	8.2	12.4	4.8	4.8	2.6	2.7
Finland	14.5	4.3	4.6	5.4	3.5	2.3	2.9
Sweden	3.2	1.4	0.9	1.1	1.4	0.4	0.8
UK	23.2	13.9	8.2	8.1	8.7	8.7	6.3
Norway	13.4	1.2	3.6	5.6	4.6	2.4	1.1

* 100 or more employees, 2007-2009 for Canada, 2000-2006 for EU
Data: Statistics Canada, Eurostat

and Ireland. For both logistics and marketing, Canadian-based companies were on the lower-end of the spectrum, not sourcing heavily internationally. This may be due to the U.S. being by far the most important international customer for Canadian-based firms and the high-level of proximity means that Canadian firms can serve this market without the need for international sourcing. The opposite is the case though for ICT services with roughly 40 percent of Canadian firms engaged in support function sourcing sourcing that activity which ranks among the leaders in the EU such as the Netherlands, Denmark and Ireland and is ahead of the UK. Germany stands out as not very engaged in international sourcing of ICT services, which may reflect the presense of an important domestic supplier. Both R&D and Engineering and other technical services are considered high-skilled activities and are likely important sources of competitive advantage for a firm. Thus, as one might expect, they are also among the least internationally sourced activties and are likely kept close to home. Canada, in particular, stands out along with Germany, for not internationally sourcing many of these activities while the UK and Ireland are among the highest.

Motivation factors for international sourcing*



* 100 or more employees, 2007-2009 for Canada, 2000-2006 for EU
Data: Statistics Canada, Eurostat

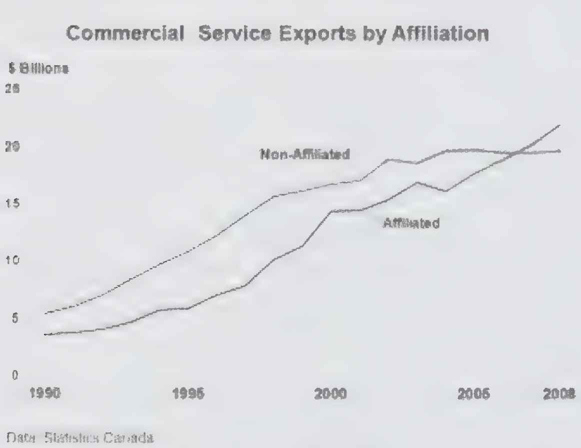
There are a great deal of similarities between the motivations reported for outsourcing by Canadian-based firms and those in the EU. For example, reduction of labour costs shows up as number one for both and with fairly similar number of firms reporting that as an

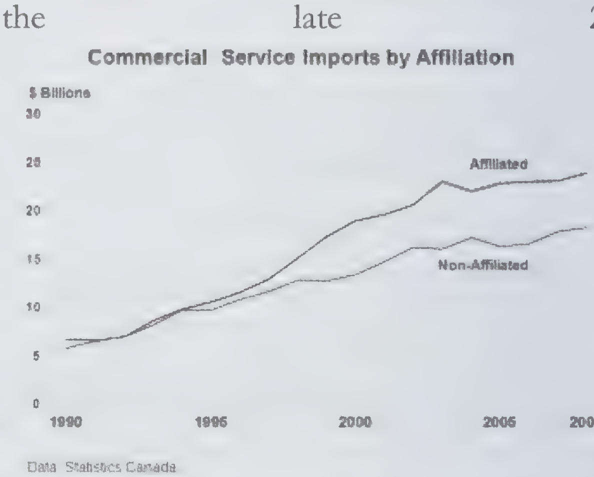
important factor.[7] A roughly similar number also reported reduction of non-labour costs as a leading factor, although this was somewhat more important for Canadian-based firms compared to their EU counterparts. Interestingly, access to new markets was reported as the second most important factor by EU firms, but only ranked fourth for Canadian. Conversely, access to specialized knowledge or technologies was reported as being far more important for Canadian firms than for EU firms. But, just as we reported earlier for Canada, there is clear evidence that and important driver of international sourcing is the changing global environment including the emergence of large and fast-growing low-wage economies, enabled by falling tariffs and new technologies, rather than the push of non-competitive environments which would have been indicated if high taxes were given as being an important push factor.

Affiliated Trade

The findings from the SIBS survey are expressed as a percentage of firms. As previously noted, almost uniquely among countries, Canada possesses a dataset that decomposes international trade in services between affiliated and non-affiliated trade; that is trade that occurs between two related parties and that which is conducted at arms-length. This data can thus be interpreted as service activity offshoring and outsourcing respectively. And, not only does it add a value dimension to the SIBS data, but it also provides a time dimension as well.

Overall we see that for Canada, services trade has been growing faster than goods trade, especially in the post 2000 period: Even though the growth in services trade decelerated, especially for exports, growth of goods trade decelerated even more sharply. We also observe that trade between affiliated companies grew significantly faster than non-affiliated trade. For service imports, affiliated and non-affiliated trade were at similar levels and growing at similar rates in the early 1990s, but in the late 1990s, the growth rate of affiliated service imports accelerated creating a gap between affiliated and non-affiliated trade of approximately $5 billion that persisted throughout the following decade. For service exports, trade between affiliated parties also accelerated in the late 1990s and not only closed the gap between affiliated and non-affiliated trade but surpassed non-affiliated trade in the late 2000s.





The ratio of affiliated to non-affiliated trade by sector may provide an indication of the types of activities that firms prefer to keep within the structure of the firm and those that

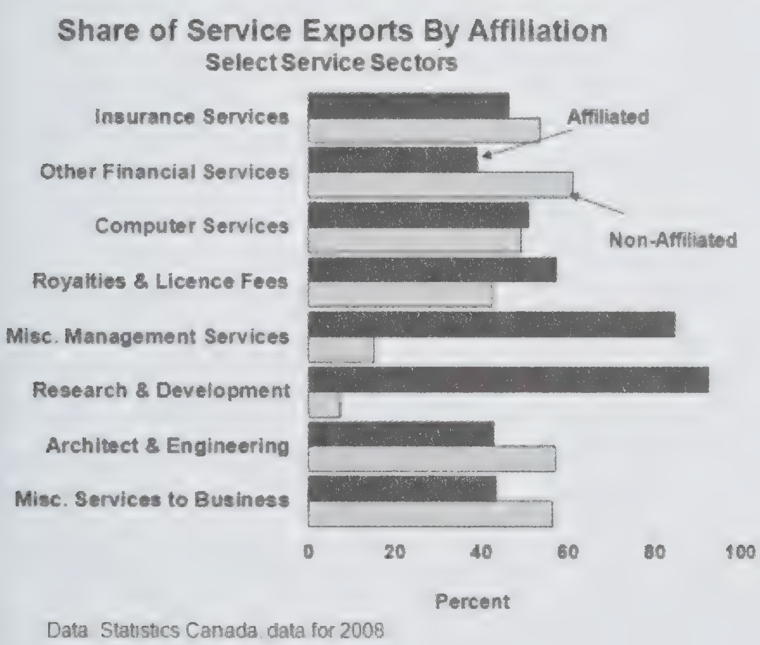
[7] Note that this figures differ somewhat than those reported earlier in this paper for Canada which combined both high and medium responses and were for firms with 20 or more employees rather than the 100+ employees to be consistent with the EuroStat data.

they are more willing to purchase externally. Looking at the most important service exports, we see that, R&D services and Miscellaneous Management Services are most often conducted between affiliates. This likely suggests that these services are difficult to contract and are considered strategic to the operation of the firms. For example, while it may be possible to contract R&D services, it would be difficult to monitor that type of activity and resulting IP may be in dispute. Likewise for management services, while there would be a role for external accountants or HR advisors, most of those activities are performed "in-house". On the other end of the scale, insurance, other financial services architectural & engineering and miscellaneous services to business all show a weak preference towards arms-length transactions. Legal services, on the other hand (not shown) indicate a strong preference for arms-length transactions. Canadian service imports largely show the same trends, although interestingly both computer, and architectural and engineering services show a modest preference for affiliated trade for imports.

Research and Development

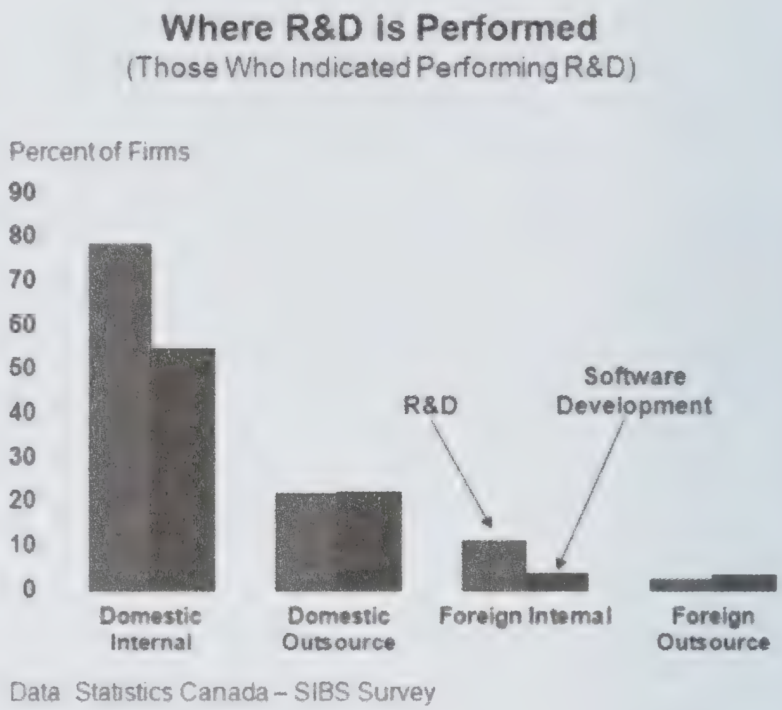
Research and Development (R&D) is often considered to be a "high-valued activity" in that it employs high-knowledge/high-skilled workers and pays relatively high wages. R&D is also thought to have considerable spillovers that accrue to the local or national economy making R&D one of the most sought after activities by most countries.[8]

Just under half of firms in industries covered by the SIBS (43.1%) and more than three-quarters (77.8%) of manufacturing firms reported doing R&D. Outside of manufacturing, the only industry where more than 50% of firms reported doing R&D was information and cultural industries. Within manufacturing, the share was the lowest in food, beverage, textile and clothing manufacturing where nearly one-third of firms reported not doing any R&D. Interestingly, many of the resource-based manufacturing industries fall around the average. Not surprisingly, in those industries that one might associate with being more technologically advanced, such as chemicals, pharmaceuticals, computers and telecom equipment, the share of firms reporting doing R&D was significantly higher, and often greater than 90%. Of note, the motor vehicle parts manufacturing industry (at 77.5%) is lower than motor vehicle manufacturing (88.9%) and Aerospace products and parts manufacturing may be lower than might be expected at 86.0%.



[8] For a more formal and complete analysis see Hall (2011) in this volume.

Large firms appear to be more innovative by this measure, with only 13.5% of large manufacturers not reporting doing any R&D, compared to 16.8% for medium and 24.2% for small firms. And this pattern holds for nearly every industry. There are a few exceptions though, such as; chemicals, pharmaceuticals and machinery industries, where small and medium-sized firms have a higher probability of conducting R&D than do larger firms.

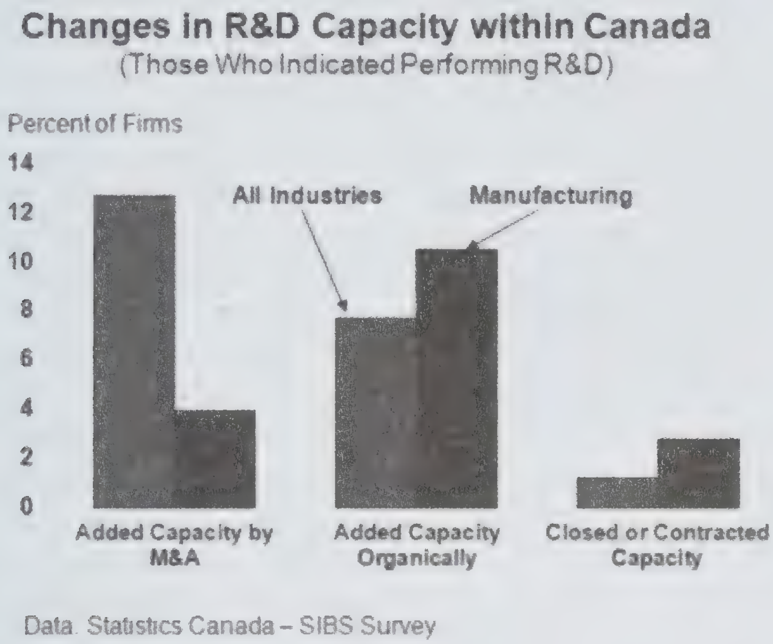


Of those firms performing R&D, the vast majority perform at least some of that R&D within the firm (as opposed to contracting it out). For example, 78.4 percent of enterprises overall and 91.3% of manufacturers which reported doing R&D did some of that R&D within their Canadian operations. 11.1 percent (10.8 percent of manufacturers) have international operations that perform R&D (i.e. outside of Canada and within the enterprise). The figures are much higher than the comparable figures for other activities such as software development, showing a clear preference for R&D to be performed within the firm. This is an expected result, as R&D is considered to be an activity that is core to the operations of the company and thus done internally. However, that does not imply that R&D is not also done outside the firm, such as through a contract. Here these shares for domestic outsourcing and foreign outsourcing are more comparable to what we observe for other activities, such as software development. An alternate interpretation may be that firms must perform some R&D internally in order to have the capacity to contract R&D externally. It is possible, for example, that a firm would require practicing R&D staff internally in order to identify potential contractors, to design projects, or to monitor work.

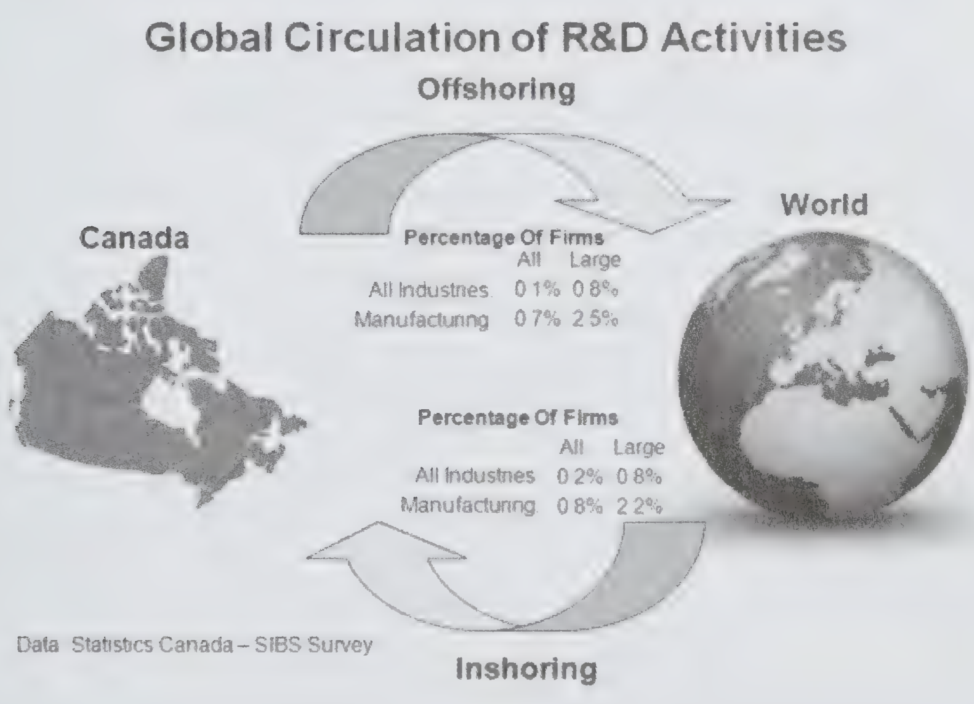
A somewhat smaller share of large firms do R&D within their Canadian operations compared to small and medium firms. This likely represents subsidiaries of foreign multinationals which do not conduct R&D in Canada. However, these same large firms are also somewhat more likely to contract out some of their R&D to other companies in Canada, and are far more likely to conduct some R&D outside of the country - they are three times more likely to be conducting some of their R&D within an affiliated company outside of Canada and close to four times as likely to be contracting out some R&D to a non-affiliated firm in another country compared to the average. This clearly reflects the larger proportion of multinational firms (both foreign and Canadian) among larger firms.

The differences can be quite striking between industries as well. In some R&D intensive industries, Chemical and Pharmaceutical industries, for example, there is a much more narrow difference between the number large firms that conduct R&D and the average. In other words, in the most R&D intensive sectors, the proportion of small and

medium firms conducting R&D is closer to the proportion for large firms, presumably because R&D is that much more of an integral activity for firms in those industries.



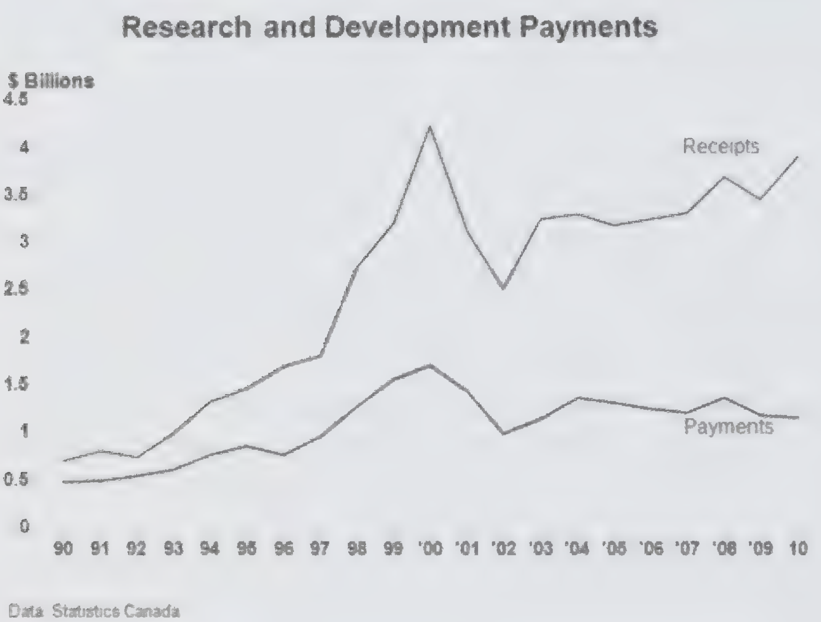
R&D is not a very footloose activity. R&D facilities are expensive to set-up with lots of fragile and immobile equipment. Possibly even more importantly, skilled employees are important for R&D and these are difficult and expensive to move. When looking at how firms expand or reduce capacity in R&D within Canada, the SIBS data reveals that for the economy overall mergers and acquisitions (M&As) was the most common method through which R&D activity was expanded (although this was much less important for manufacturers). M&As, however, are more about changing ownership of existing R&D rather than a true expansion. Just under eight percent of firms indicated that they added capacity within Canada organically, that is through opening a new facility or expanding existing capacity, between 2007 and 2009. For manufacturing, it was even higher at 10.5 percent and far more important than expanding capacity through M&As. But, as predicted, R&D activity was rarely eliminated. Only 1.3 percent of firms, and 2.8 percent of manufacturers, closed R&D operations or reduced capacity from 2007 to 2009. Given that this period includes the global financial crisis, these low values are even more notable and reinforce the idea that while R&D may be globalizing, it is can be characterized more as an



expansion of R&D activity rather than a movement.

Although R&D activities are less footloose than many other activities, we do see a circular flow similar to that described for offshoring and insourcing more generally. And, similar to the overall picture, there is evidence of a modest net tendency in favour of inshoring (i.e. inshoring is greater than offshoring as measured by the number of firms participating in both activities). Again, it is important to be cautious when interpreting these figures as they represent the number of firms offshoring or inshoring rather than values, but this may indicate that Canada possesses a comparative advantage in undertaking R&D activities, which is a surprising finding given the ongoing concern in Canadian policy circles about Canada's underperformance in innovation and R&D. Business expenditure on R&D (BERD) as share of GDP was only 1.0% for Canada in 2008, compared to an OECD average of 1.6%.[9]

But, this finding that Canada may be an attractive location for international R&D activity is further supported by evidence from Canada's international balance of payments which provides the value of R&D payments. This data shows that Canada has maintained a surplus in international R&D payments, which grew from relatively modest levels in the early 1990s to a fairly substantial surplus by 2010. Indeed, R&D receipts, in 2010 were nearly four times as large as payments and at $3.9 billion R&D receipts are fairly significant in scale as well.

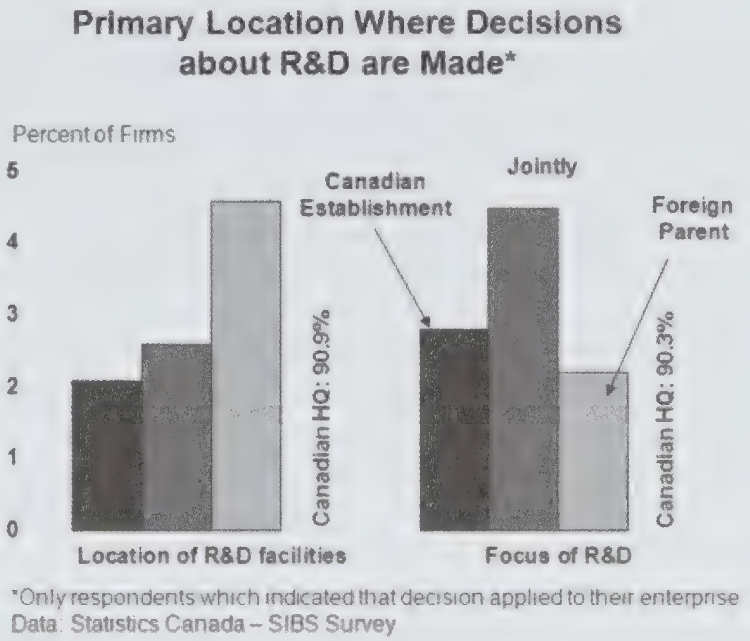


An important aspect of global value chains is understanding who, within the chain, makes decisions about offshoring and outsourcing. This is especially true for decisions about the location of R&D since, as we have already seen, R&D activities are not as footloose as other activities and thus decisions about their location can have long-lasting impacts.

Most firms in the Canadian economy, especially small and medium-sized firms, have no foreign operations. Thus, by definition, the decision by these firms where to locate R&D activities or whether to outsource is made in Canada. On the other hand, a Canadian-owned company with subsidiaries abroad could delegate some of the decisions to the foreign subs, but if a decision is made at the headquarters, it will be made by the Canadian headquarters. Foreign-controlled companies can choose to make decisions at the foreign headquarters, the Canadian HQ or at the Canadian subs, or some combination of the above. Understanding where these foreign-owned enterprises, which have the most options, make their decisions is thus an important issue for policy-makers in Canada.

9 OECD Main Science and Technology Indicators, 2011/1

40.9 percent of large manufacturing firms responding to the SIBS survey indicated that they were foreign-owned.[10] But, despite this high degree of foreign ownership, only 27.8 percent of large manufacturers indicated that decisions on the location of R&D facilities were primarily made by the foreign parent. An additional 10.5 percent indicated that the decision is made jointly by the Canadian head office and the foreign parent. The rest indicated that the decision was primarily made by the Canadian head office or by the Canadian subsidiaries. By contrast, when it comes to determining the focus of R&D the decision was delegated to the Canadian operations to an even greater extent. For example, 22.3 percent indicated that the decision relating to the focus of R&D was made solely by the foreign parent. Whereas 14.4 percent indicated that the decision is made jointly by the foreign parent and the Canadian head office. This indicates that most multinationals, including foreign-owned companies, delegate at least some of the decision making on where to locate R&D activities to their Canadian operations and delegate to an even greater extent on the focus of that R&D.



Conclusions

The objective of this chapter was to develop a better understanding of how companies located in Canada participate in global value chains (GVCs) with a focus on offshoring and outsourcing through the analysis of a newly constructed dataset based on the Survey of Innovation and Business Strategies (SIBS). This chapter also looked at the why firms undertake offshoring and outsourcing, the obstacles that they face, and importantly how the trends in Canada compare to other countries.

Our analysis indicates that offshoring and outsourcing are relatively rare compared to the media attention that it generates. Large firms do participate more in offshoring and outsourcing than do medium-sized firms and much more than small firms, although they are important differences between industries. Possibly more striking is the that these trends are not one-way outward flows as some would suggest, but rather circular movements with some activities leaving Canada while others move in through domestic sourcing and inshoring.

Supporting the finding that offshoring and outsourcing is characterized as circular flows is that pull factors (those attracting activities to other countries), such as; lowering costs, accessing new markets, and accessing needed skills or knowledge are the most important drivers compelling Canadian-based companies to engage in GVCs. Push factors

[10] Those reporting that the enterprises' head office was located outside of Canada.

(those that might drive activities out of Canada), such as uncompetitive domestic economic environments or taxes are considerably less important.

This is an important finding for policy makers as it changes the policy question from one of how to limit offshoring and outsourcing to one of maximizing the gains by establishing a policy environment that will attract and retain the highest valued activities to Canada while allowing others to be moved to where they are conducted most efficiently and thus improving the competitiveness of Canadian-based companies. If that is the case, then it is important to understand the barriers that companies in Canada face when participating in GVCs. The analysis of the survey results show that many of the most important obstacles are those that would be expected when dealing with unfamiliar markets such as identifying suppliers and dealing with local customs and laws, which may suggest a role for programs such as Canada's Trade Commissioner service. Tariff rates were also identified as an important obstacle for manufacturers, indicating that there is still room for tariff rates to be further reduced.

Comparing the level of engagement in GVCs by Canadian companies and those in the EU reveals that, on average, Canadian companies are about as involved in GVCs as those in the EU. This, however, hides considerable differences between countries. Compared to the leading countries, such as Ireland and the UK, Canadian companies are not nearly as involved in GVCs. This is particularly true outside of the manufacturing sector where levels of engagement in GVCs in the EU are higher than in Canada. While this may reflect differences in survey coverage, it is definitely an area that could benefit from more careful examination.

One of the most sought-after activities is research and development (R&D) due to perceptions that this activity supports high-paying jobs and produces significant spillovers to the host economy. Although Canada is often thought to be laggard in its R&D performance compared to other developed countries, evidence suggests that Canada may have a comparative advantage in this activity. Not only does the SIBS survey indicate that a somewhat greater proportion of firms inshored R&D than offshored it, but the balance of payments figures on the value of trade also indicate that R&D exports are substantially larger than R&D imports.

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Annex 1: Overview of the Survey of Innovation and Business Strategies (SIBS)

The Survey of Innovation and Business Strategy (SIBS) was undertaken in order to better understand the market and policy factors that encourage or discourage the adoption of entrepreneurial and innovation-oriented business strategies.[11] The survey also provides detailed information about global value chain management practices and activities in Canada, such as which activities businesses relocate to other countries and which ones they outsource to external suppliers.

Between January and April 2010, a sample of 6,233 enterprises in Canada with more than 20 employees and spanning 67 industries were surveyed. Questionnaires, which integrated various innovative features from other business surveys around the world, were sent to the CEOs or senior managers of these enterprises. The survey response rate was 70 percent.

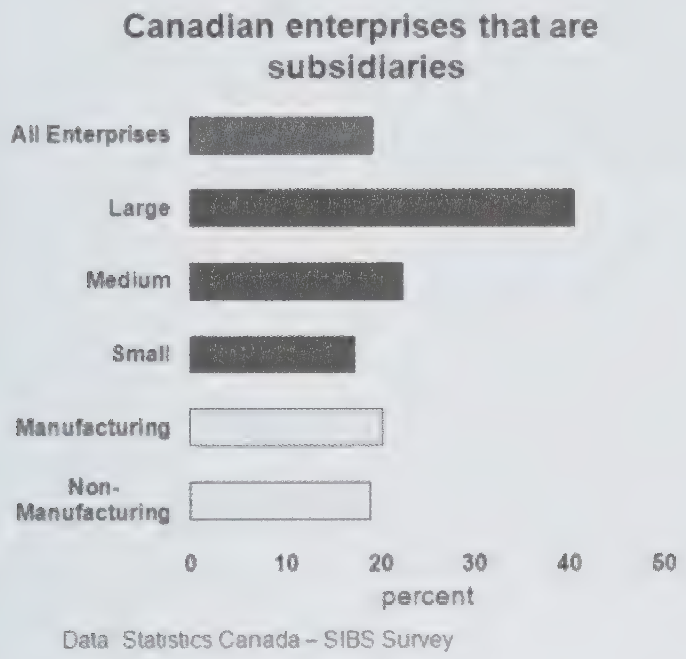
Of the 6,233 surveyed enterprises, 70%, or 4,394 enterprises were manufacturers (NAICS 31-33). The remaining 1,839 enterprises represented a sample of non-manufacturing sectors of the Canadian economy[12]. For the industries surveyed, the sample size was sufficient to allow for representative estimates to be produced. However, it should be noted the SIBS sample of surveyed enterprises does not represent a complete picture of the Canadian economy as some sectors were not included, such as; educational services, health care, arts and entertainment, accommodation and food services and public administration. Thus, measures that are reported as being for the total economy exlcude these sectors.

Of the respondents to the survey, nearly 1 in 4 enterprises, and 1 out of 2 in the manufacturing sector, reported as having some business activities outside of Canada.

The vast majority, 94 percent, of respondents were headquartered in Canada. For those with head offices in other countries, the U.S. was the main location (4.5%) while another 1.0% located in Europe and the reminder in Asia and

[11] The SIBS was a joint effort by Industry Canada, Foreign Affairs and International Trade Canada and Statistics Canada.

[12] These sectors include; agriculture, forestry and fishing , mining oil and gas extraction, utilities, construction, retail trade, transportation and warehousing, information and cultural industries, finance and insurance, real estate, professional services, and other sectors.



other locations. While the percentage of companies with Canadian head offices is high, it is significantly lower for large firms (77%) and manufacturing enterprises (88%).[13]

The SIBS survey also indicates that almost one in five enterprises operating in Canada (19%) are subsidiaries of other enterprise. For large firms, the percentage of subsidiaries is even greater, with 41% of large enterprises indicating they were a subsidiary of another firm.

[13] The SIBS survey categorizes enterprises into three size groups; small enterprises are those with 20 to 99 employees, medium enterprises are those with 100 to 249 employees, while enterprises with at least 250 employees are considered large.

The Internationalization of R&D

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UC Berkeley and University of Maastricht

Introduction

In the past decade, policymakers and others in a number of developed countries have expressed concern that firms in their countries appear to be increasingly locating their R&D facilities outside the home country. For example, in Foray and van Ark (2007), we read:

> "There are concerns expressed at different levels in Europe about the increasing numbers of European companies which are basing their R&D operations outside Europe, at the same time as the number of overseas companies carrying out their R&D in Europe is falling."[1]

The introduction of a recent study from the United States National Academies had this to say:

> "….the committee is deeply concerned that the scientific and technological building blocks critical to our economic leadership are eroding at a time when many other nations are gathering strength."[2]

There is no doubt about the facts: in just ten years between 1995 and 2004, the share of R&D spent outside the home country by Western European multinationals increased from 26 per cent to 44 per cent, by Japanese multinationals from 5 per cent to 11 percent, and in North American multinationals from 23 per cent to 32 per cent (OECD, 2005). Since then has come the growth of investments by these same multinationals in developing economies, especially Brazil, India, and China. We lack very precise data on the extent of this trend, but recent anecdotal evidence is quite persuasive. The Economist reports that companies in the Fortune 500 have 98 R&D facilities in China and 63 in India (Economist 2010). A recent report by Goldman Sachs identifies new and planned R&D facilities in China, India, and Brazil by such companies as Pfizer, Ford, Microsoft, IBM, Boeing, Intel, and Cisco (Goldman Sachs Group 2010).

Are the concerns voiced above justified? There are good reasons to think they may be. The existence of cross-national spillovers does suggest that countries can benefit from R&D done elsewhere and therefore should free-ride on that R&D to some extent (Keller 2010). However, the need for development of some absorptive capacity, and the localization of some spillovers would suggest that it is useful to have at least some R&D done within a country (Feldman and Kogler 2010). Also to the extent that successful R&D creates short term rents, both for firms and for their employees, it is viewed as desirable to

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[1] Foray and van Ark (2007), p. 1.

[2] National Research Council (2006), p. 2.

keep it at home. That is, firms introducing innovative products and services are likely to earn supra-normal profits at least for short periods and such profits are usually shared with employees (Blanchflower *et al.* 1996).

Table 1: Share of R&D Budget Spent Outside the Home Country – 209 MNEs

	1995	*1998*	*2001*	*2004 (est.)*
Western Europe	25.7	30.3	33.4	43.7
Japan	4.7	7.0	10.5	14.6
North America	23.2	28.4	31.7	35.1

Percents, based on a survey of 209 MNEs. The geographic zones refer to the origin of the MNEs.

Source: Reger (2002)

There are also demand issues related to R&D location – consumers that are close to the location of the R&D may be better served by that R&D. The most obvious example of this is linguistic – English-speaking internet users, especially those in the United States, have found that new products are more often introduced first in their market and only later translated and diffused to other markets after first achieving a level of success in the home market. However, the experience with pharmaceuticals suggests that R&D is also attracted to environments where prices are expected to be higher due to less regulation, allowing the high fixed cost in this sector to be covered by the home market. This suggests that in some cases consumers may not necessarily benefit more than foreign consumers from R&D located in their market.

The downside of countries competing to attract R&D investment is that it can lead to wasteful tax competition, where countries and locations compete to attract this kind of investment, dissipating taxpayer funds without achieving much movement. The spread of the R&D tax credit around the world is viewed by some as an example of this phenomenon. Currently, the UK is introducing a "patent box" whereby income attributed to patents is taxed at 10 per cent rather than the usual corporate rate of 28 per cent, partly in competition with the Netherlands and Belgium, who have such a scheme. Most innovation economists view this kind of highly targeted policy as likely to cost more than the benefits that might accrue to the UK (Griffith and Miller, 2010). In general, however, tax credits seem to have led to an increase in R&D everywhere they have been used (Hall and Van Reenen, 2000).

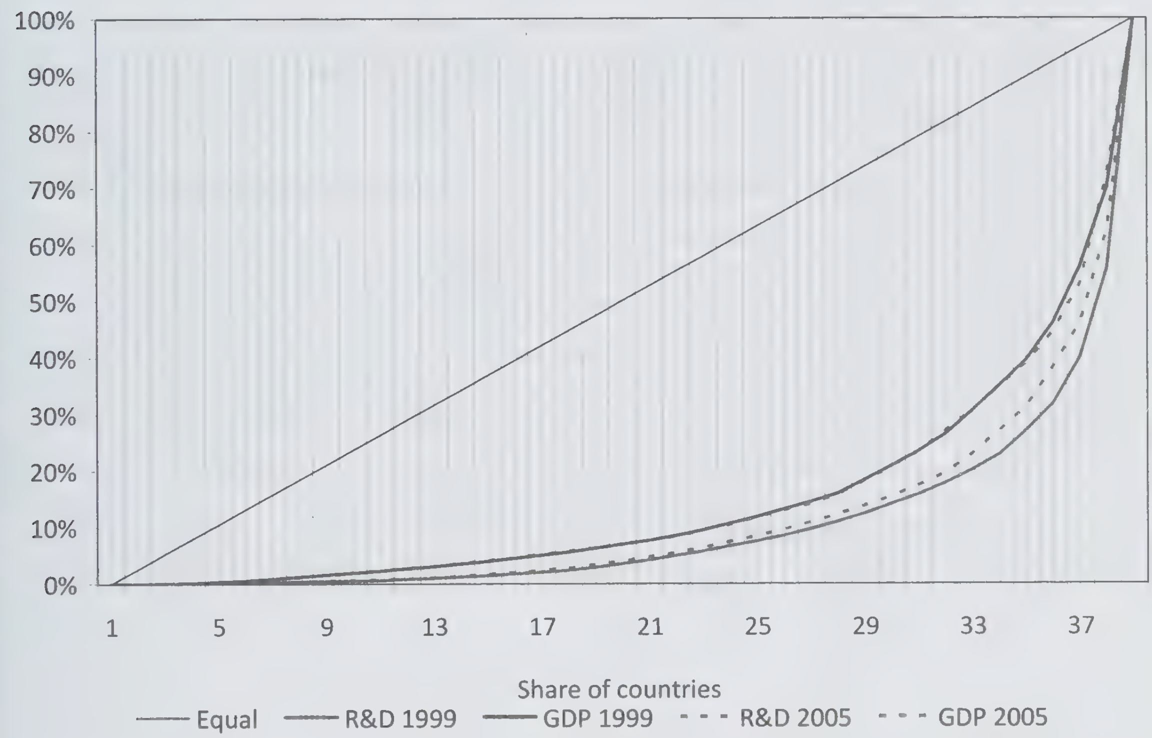
The remainder of this paper looks at the evidence on three specific questions about the internationalization of R&D activities: First, is there evidence that R&D is becoming more internationalized (more footloose)? The short answer to this question is yes, in spite of the fact that the data on internationalization is often not ideal and can be somewhat spotty. Second, what are the factors that influence the choice of location for R&D? There are a large number of studies on this question from which it is possible to draw a few fairly strong conclusions, in spite of the fact that the studies are often not completely comparable.

The third question asks how this is changing over time. Obviously it is fairly straightforward to look at the trends in location, but somewhat more difficult to determine whether the influence of the underlying factors has been changing. The paper concludes with a discussion of the implications for Canada.

Facts about the internationalization of R&D

Figure 1 shows the Gini distribution of GDP and business R&D during two different recent time periods, 1999 and 2005, for approximately 40 large OECD and non-OECD countries. Two basic facts about the distribution of GDP and R&D performance are apparent in this figure. First, R&D performance is slightly more concentrated than GDP (Gini coefficients of 0.78 in 1999 and 0.75 in 2005 as opposed to 0.69 in both years for GDP).[3] Second, R&D has been becoming less concentrated over time, even during this brief six year period, in contrast to the GDP concentration, which has remain essentially unchanged. This change, although it appears small, reflects the internationalization of R&D that has taken place during the same period.

Figure 1: Gini plot of worldwide business R&D spending and GDP for 40 large OECD and non-OECD countries



Consistent time series with a long history for the internationalization of R&D is very difficult to construct, due to the lack of data sources. The OECD, Eurostat, NSF, and UNESCO supply aggregate trends in various reports, for a varying list of countries and regions. With the exception of UNESCO, these agencies tend to concentrate on the developed part of the world, plus the very largest emerging economies. Almost all of the data available is quite spotty with many missing values, so precise trends are difficult to discern.[4] Ideally one would like a set of matrices of sending and receiving countries with the amount of cross-border R&D in each cell, one for each year, along with the equivalent

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[3] The Gini coefficient is defined as one minus the area under the curve divided by the area under the 45 degree line. Therefore a Gini of zero implies a completely equal distribution and a Gini of one means that on country has all the income.

[4] One reason for the spottiness is that many countries only survey their R&D-performers every other or every third year. This is fairly easy to correct for, since R&D evolves rather slowly, and I discuss later how I have interpolated where necessary.

domestic R&D series for each country. This would allow for the creation of series in a number of ways. Such data exists in bits and pieces, but there is relatively little available after around 2005.

For the US, although the SEC mandates geographical segment reporting for publicly traded firms that operate in multiple countries, the firms are left free to define the segments themselves, and rarely report their R&D broken down in any meaningful way. A look at the geographic segments file of Standard and Poor's Compustat data reveals that the only two firms that report informative and reasonably lengthy time series of the geographical distribution of their R&D spending are German: Bayer AG and Schering AG, and the latter exited the file in 2005. The best source for the United States is the data collected by the Bureau of Economic Analysis in conjunction with the Census Bureau (U. S. BEA, 2005; Yorgason, 2007), but their study of 1997-1999 and 2004 data appears to be a pilot that has not yet led to a standard annual statistical report.

The most comprehensive set of worldwide figures for inward R&D are the statistics collected by UNESCO on the source of funding for R&D within approximately 200 countries worldwide (UNESCO 2010). These data give the shares of domestic R&D funded from abroad for a much larger number of countries than any of the other sources, in principle for every year between 1996 and 2007. Of course, not all countries are able to supply data: 82 report some R&D funded from abroad during at least one of the years, one reports that it received no funding from abroad during the entire period, and 104 have no data at all during this period (or possibly no R&D at all, in most of the cases). Table 2 presents total R&D, R&D funded from abroad, and R&D funded by the business sector in the year 2005 for all countries that report more than one billion dollars of R&D, accounting from more than 99 per cent of worldwide R&D. [5,6] Most countries have an externally funded R&D share in the 5 to 15 per cent range, with a few higher (Ukraine, Greece, United Kingdom), and the aggregate share is 5.8 per cent in 2005.

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[5] All of the R&D data in this paper have been converted to real US dollars using the GDP deflator base 2005 and Purchasing Power Parity given by the Penn World Tables (Heston, Summers, and Aten 2009).

[6] Note that the U. S. data in this chart do not come directly from UNESCO, since the U. S. combines the R&D funded from abroad with R&D funded by the business sector. It is probable that the U.S. RD-1 survey on which these numbers are based does not track the ultimate owner of the R&D-performer in the U.S. This may be a problem for other countries too (Japan?), although the U. S. is the most egregious case.

Table 2: Total and externally funded R&D

Country	Total R&D Billions of 2005 dollars (PPP)	Externally-funded R&D Billions of 2005 dollars (PPP)	Share externally funded per cent	Business sector R&D Billions of 2005 dollars (PPP)
United States*	323.8530	27.1065	8.37%	207.8410
Japan	126.2105	0.4381	0.35%	96.0738
China*	109.9588	1.0184	1.27%	73.7177
Germany	60.4835	2.2664	3.75%	40.8716
France	38.1810	2.8745	7.53%	19.8291
United Kingdom	32.1844	6.2024	19.27%	13.5367
India	30.1648			4.7125
Canada	22.9354	2.1809	9.51%	11.2110
Italy	17.7025	1.4092	7.96%	7.0214
Russia	17.6578	1.3411	7.59%	5.2980
Brazil	16.4858			7.9786
Spain	13.1997	0.7582	5.74%	6.1101
Australia	13.1448	0.3586	2.73%	7.4529
Sweden	9.9449	0.8075	8.12%	6.3506
Netherlands	9.3032	1.0209	10.97%	4.6205
Switzerland	7.5151	0.3930	5.23%	5.2405
Israel	6.7889	0.2221	3.27%	5.1208
Austria	6.6725	1.1825	17.72%	3.0478
Belgium	6.0499	0.7505	12.40%	3.6106
Mexico	5.6507	0.0421	0.75%	2.6268
Finland	5.4149	0.3401	6.28%	3.6203
Iran	4.5165			0.5505
Denmark	4.2732	0.4303	10.07%	2.5437
South Africa	4.2158	0.5714	13.55%	1.8494
Ukraine	4.1454	1.0106	24.38%	1.3371
Turkey	4.1341	0.0325	0.79%	1.7903
Singapore	3.8908	0.1699	4.37%	2.2859
Norway	3.1958	0.2567	8.03%	1.4831
Czech Republic	2.8091	0.1111	3.96%	1.5194
Poland	2.7687	0.1590	5.74%	0.9234
Argentina	2.4558	0.0207	0.84%	0.7618
Malaysia	2.4347	0.0065	0.27%	1.8915
Hong Kong	2.0787	0.0512	2.46%	1.1015
Pakistan	1.9866	0.0069	0.35%	
Ireland	1.9530	0.1685	8.63%	1.1220
Chile	1.7211	0.1492	8.67%	0.7892
Portugal	1.6661	0.0783	4.70%	0.6042
Greece	1.5780	0.2996	18.99%	0.4902
Hungary	1.5287	0.1631	10.67%	0.6030
Thailand	1.3184	0.0242	1.84%	0.6415
Belarus	1.2265	0.0767	6.25%	0.2603
New Zealand	1.1565	0.0602	5.20%	0.4748
Total in top 42 countries	**934.5554**	**54.5595**	**5.84%**	**558.9148**
Other countries	2.6659	0.2630	9.86%	0.2949
Share in other countries	0.29%	0.48%		0.05%

Source: UNESCO Institute of Statistics (2010). Science and Technology statistics.

Author's computations using the Penn World Tables version 6.3, R&D data interpolated where necessary.

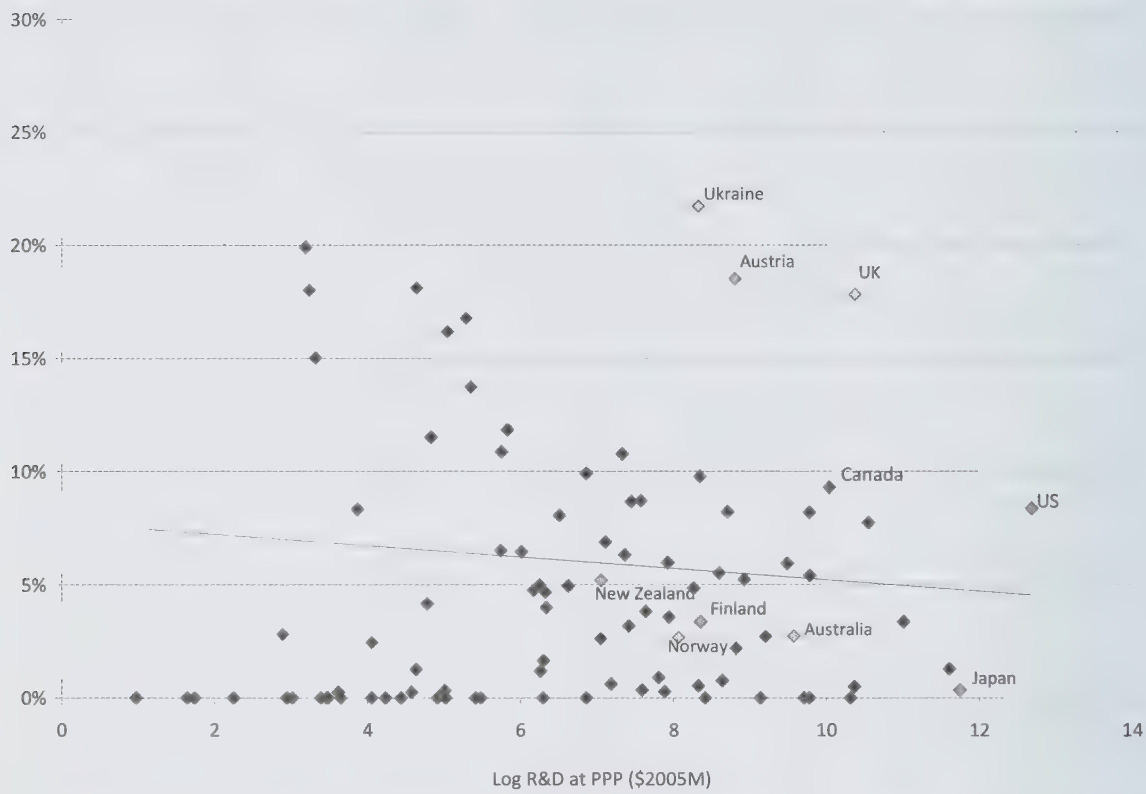
* from UNESCO Table 14; numbers from Inst of Statistics were incomplete.

Countries with more than $1 billion in R&D

Figure 2 shows the share of R&D funded from abroad for all countries, averaged over the 2004-2006 period to maximize data availability, versus the logarithm of the level of R&D in 2005. There is a very slight negative relationship between the two, as one might have expected, plus a few outliers (Uganda and Panama), where most of the R&D

spending comes from abroad. Among the larger R&D intensive countries, Canada is on the high side – a lower foreign share than the UK, but about the same as the United States and Ireland.

Figure 2: R&D share from abroad versus R&D level in 2005, by country



The OECD presents figures for *both* inward and outward R&D (OECD, 2005, Hatzichronoglou, 2007) that are derived from their AFA Database. However, as Hatzichronoglou (2007) and Wyckoff and Hatzichronoglou (2003) are careful to point out, the data needed to create a true picture of cross-border investment in general are very difficult to come by. OECD data relies mainly on reports by their member countries, which are fairly accurate about firm behavior within the national boundary, but rarely cover information on affiliates of domestic firms that are located in other countries, partly for legal reasons. Thus much of the recent growth in cross-border R&D outside the OECD cannot be captured by data collected by OECD countries, and even within these countries there are questions about the complete reliability of ultimate ownership information.

Some figures from the OECD are shown in Tables 3 and 4. Table 3a reproduces Table 1.3 in OECD (2008) which appears to be based on a combination of reported inward and outward R&D in manufacturing. The only countries that report outward R&D broken down by destination are Italy, Japan, and the United States. Therefore this table was partly based on the inward R&D figures, which are available only for the manufacturing sector; the data shown are for 2003. Multinational enterprises account for more than two-thirds of worldwide business R&D (UNCTAD 2005) and they are the main players in the internationalization of R&D. Western European firms are the most likely to locate R&D outside the country, followed closely by North American firms, and then by Japan. A great deal of this R&D goes to the US. As a location for foreign R&D, Canada ranks 7th in the world (after the US, UK, China, France, Japan, India).

Table 3a: Share of R&D expenditures of foreign affiliates abroad by country of destination, 2003

	Source country				
Destination	United States	Japan	Germany	France	United Kingdom
US		**47%**	**69%**	**35%**	**63%**
France	9%	5%	10%		2%
UK	18%	9%	5%	16%	
Japan	8%		4%	20%	2%
Italy	4%	2%	3%	2%	2%
Belgium	2%	3%	2%	4%	2%
Netherlands	3%	8%	1%	2%	2%
Germany	19%	5%		18%	11%
Sweden	4%	0%	0%	0%	15%
Other	**33%**	19%	2%	1%	1%

Source: OECD, AFA Database, January 2008

Table 3b is also drawn from the OECD AFA Database, but it shows the complete breakdown of total business sector (rather than manufacturing only) outward R&D for the three countries that report meaningful data. For Japan and the United States, the data for both 2003 and 2007 is available, which allows us to get some idea of changes in multinational R&D strategy. Both countries appear to have shifted their R&D somewhat away from developed countries towards developing countries, more for Japan than for the United States. The amount of R&D shifted is probably less than the growth in R&D between 2003 and 2007, however. The table also shows that the share of U.S. business R&D going to Canada has declined significantly between 2003 and 2007, although in real expenditure terms the amounts hardly changed, from 2.58 to 2.57 billion US 2005 dollars.

The final column of Table 3b gives us an impression of the relative importance of various regions for U. S. business sector R&D. It shows the inward flow of R&D from the U. S. as a share of total GDP. The OECD sector (including all of Europe) receives R&D investment at four times the rate of the non-OECD sector given the size of their economies. In order of relative importance, the main recipient countries are Ireland, Israel, Sweden, Belgium, the United Kingdom, Singapore, Germany, and Canada. As a share of GDP, external business sector R&D has fallen slightly in Canada between 2003 and 2007, from 0.25 per cent to 0.22 per cent, which is a decline of about one tenth. Note also that both India and China still receive very little R&D investment from the United States relative to the size of their economies.

Table 3b: Share of total business R&D

	Source country					Share of GDP*
Destination	Italy in 2003	Japan in 2003	Japan in 2007	US in 2003	US in 2007	US in 2007
United States	9.9%	49.1%	50.4%			
Canada	5.7%			10.7%	7.8%	0.22%
Australia & NZ	0.0%			1.9%	3.2%	0.12%
Belgium	0.6%			2.0%	3.4%	0.32%
France	28.3%	2.7%	1.9%	7.8%	4.8%	0.08%
Germany	19.7%	6.2%	5.7%	17.1%	17.0%	0.22%
Ireland	1.0%			2.6%	4.3%	0.83%
Netherlands	1.2%			2.3%	2.1%	0.12%
Sweden	0.5%			6.1%	4.4%	0.49%
United Kingdom	5.2%	10.4%	7.7%	19.2%	18.6%	0.31%
Other Europe	26.0%	17.1%	11.8%	8.3%	11.3%	0.04%
Israel	0.0%			3.0%	2.7%	0.53%
Japan	0.0%			7.2%	5.7%	0.05%
China, incl. HK	0.1%			3.5%	3.5%	0.01%
Singapore	0.2%			2.3%	1.7%	0.27%
India	0.2%			0.4%	1.3%	0.01%
Other Asia	0.5%	10.9%	16.1%	4.1%	4.6%	0.03%
Latin America	2.2%			1.5%	3.3%	0.05%
ROW, incl. Africa	0.1%	3.6%	6.4%		0.2%	0.00%
Total, OECD+	98.1%	85.5%	77.5%	88.2%	85.5%	0.08%
Total, non-OECD	3.3%	14.5%	22.5%	11.7%	14.5%	0.02%

Source: OECD, AFA Database, January 2008, outward R&D data

\+ OECD countries plus the remainder of Europe

* This is the external R&D share of destination country GDP

Table 4 looks at the data a different way, using the inward R&D measures for manufacturing from the AFA Database in 2005. From these it is possible to produce a fairly complete cross-tabulation of flows, albeit one limited to the manufacturing sector. The bottom panel of the table gives the worldwide share of cross-border R&D accounted for by each cell. Thus one can see that Canadian firms conduct 0.8 per cent of the total cross-border R&D, whereas firms from other countries conduct 5.3 per cent within Canada. All but 9.4 per cent of cross-border R&D is between the triad plus Canada. Figure 3, based on the worldwide shares of cross-border R&D presented in Table 4, gives an idea of the "trade balance" for R&D. It shows that Europe and the US, to a lesser extent, are net exporters of R&D spending, while Canada, Japan, and the rest of Asia (including China) are net importers. Africa, the Middle East, and Latin America barely participate.

Table 4: Source and Destination Region for Multinational R&D

	R&D performed in destination region (2005 M dollars, at PPP)							
Source region	Canada	Europe	USA	Japan	Asia/Pac excl. Japan	Africa & Middle East	Latin America	Total
Canada	--	274	183	8	--	--	--	465
Europe	552	--	21457	4268	--	--	--	26277
USA	2433	18638	--	2308	2456	841	433	27109
Japan	93	915	1225	--	377	--	--	2610
Asia/Pac excl. Japan	0	38	203	8	--	--	--	249
Africa & Middle East	0	12	121	0	--	--	--	133
Latin America	0	0	826	25	--	--	--	851
Total	**3078**	**19877**	**24015**	**6617**	**2833**	**841**	**433**	**57694**
	Share of cross-border R&D							
Canada		0.5%	0.3%	0.0%				0.8%
Europe	1.0%		37.2%	7.4%				45.5%
USA	4.2%	32.3%		4.0%	4.3%	1.5%	0.8%	47.0%
Japan	0.2%	1.6%	2.1%		0.7%			4.5%
Asia/Pac excl. Japan		0.1%	0.4%					0.4%
Africa & Middle East			0.2%					0.2%
Latin America			1.4%					1.4%
	5.3%	**34.4%**	**41.6%**	**11.4%**	**4.9%**	**1.5%**	**0.8%**	

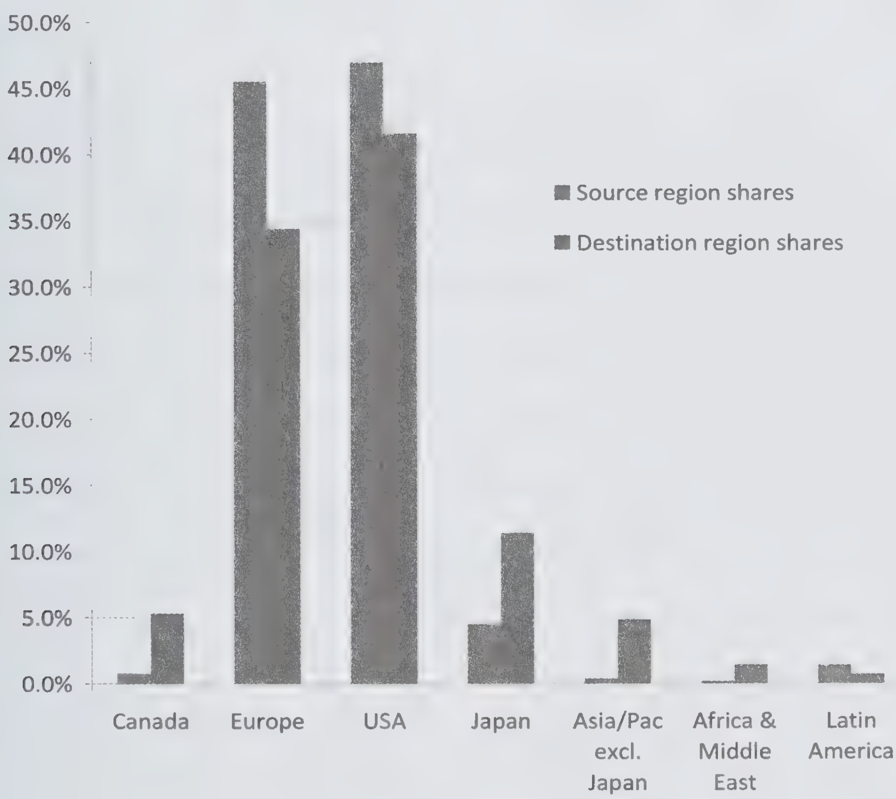
Numbers are total mfg R&D in 2005, from OECD AFA Databse

Where data is partly missing, averages over 2004-2006 have been used if possible

Cells denoted "--" have no data available in the source; in some cases they are likely to be zero.

Source: OECD, AFA Database, January 2008, outward R&D data

Figure 3: Distribution of cross-border R&D shares

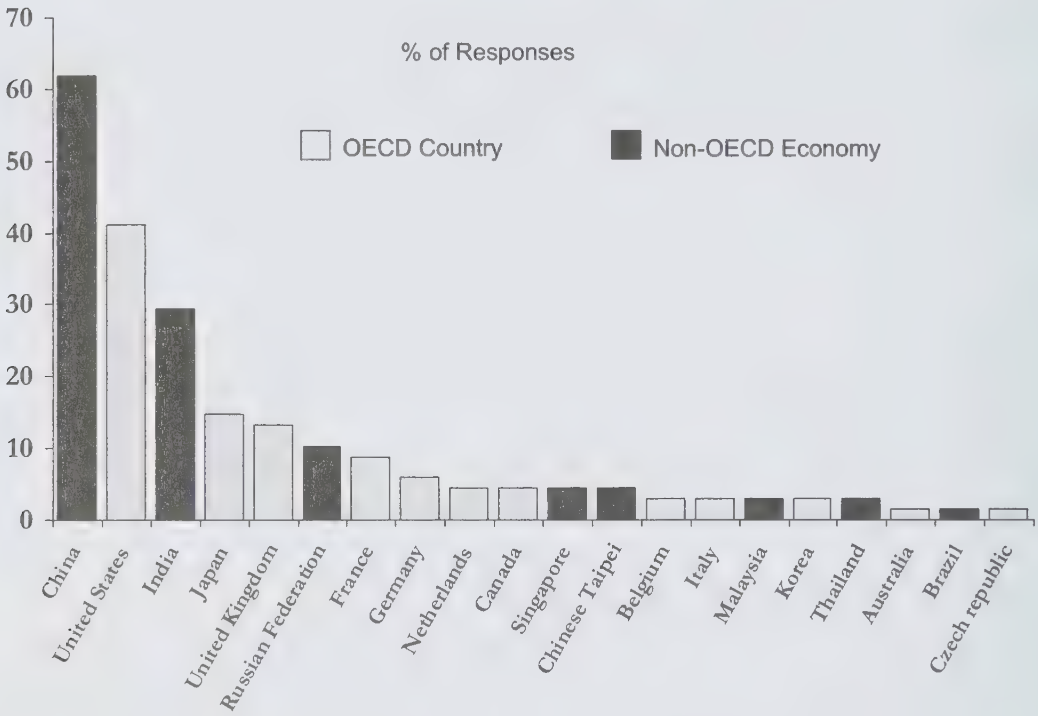


Source: OECD/AFA Database

Figure 4 shows how things are changing. It contains the results of a survey of the largest R&D-performers worldwide conducted by UNCTAD in 2004. The figure shows

the responses to a question about future R&D locations asked of these firms. A full 60 per cent of the responses mentioned China, although only 35 per cent of the firms already had a lab in that country. Nevertheless, the United States was still highly favored, followed by India (where 20 per cent of the firms currently have a lab). Few of the other countries were mentioned by more than 10 per cent of the respondents. So the trend towards China as an R&D location (and to a lesser extent, India) is very clear.

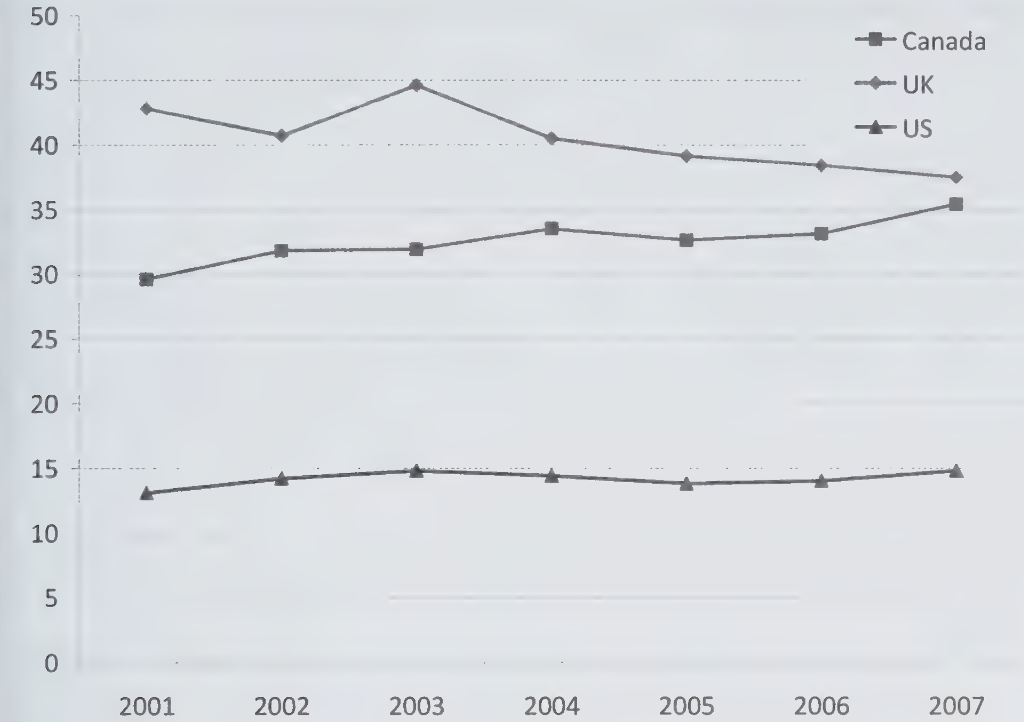
Figure 4. Most attractive foreign R&D locations



Source: OECD Science, Technology and Industry Outlook 2006

Figure 5, also drawn from the OECD/AFA database but based on Statistics Canada data, takes a closer look at the evolution of foreign controlled R&D as a share of total business enterprise R&D in Canada. For comparison, the US and the UK are shown. During the 2001-2007 period, the share of foreign-controlled R&D in the UK declined from about 43 per cent to 38 per cent, while that in Canada rose from 30 per cent to 35 per cent. The US share remained roughly constant at 15 per cent. So there is little evidence in these data that R&D is moving away from Canada. Table 5 shows a sectoral breakdown for these figures. Chemicals, transport equipment, and computing machinery have a foreign-controlled R&D share greater than 60 per cent, probably mostly from US firms.

Figure 5: Share of total business enterprise R&D controlled from abroad



Source: OECD/AFA Database

Table 5: Foreign-controlled R&D in Canada by 2-digit industry

	Foreign-controlled share		*Foreign-controlled ($M Canadian)*	
ISIC3	*2001*	*2007*	*2001*	*2007*
Mining and quarrying	29.9	53.2	64	292
Food, beverages and tobacco	28.7	29.3	27	49
Textiles, wearing apparel, leather, footwear	71.5		68	
Wood and paper products, publishing, printing	9.2	20.0	30	82
All chemical products	71.0	57.8	833	942
Drugs and medicines	80.9		665	
Rubber and plastic products	25.8	21.2	20	24
Non-metallic mineral products	14.0		3	
Basic and fabricated metal products	8.6	51.5	33	272
Non-electrical machinery and equipment	55.9	26.7	463	184
Machinery and equipment n.e.c.	26.7	20.1	93	118
Office, accounting and computing machinery	77.1	63.5	370	66
Electrical machinery and apparatus n.e.c.	58.3		178	
Radio, TV and communication equipment	9.0	9.1	363	132
Medical, precision, opt. instruments	32.6		88	
Motor vehicles	60.8	63.8	216	308
Other transport equipment	57.2	56.6	559	572
Aircraft and spacecraft			545	
Furniture, recycling and manufacturing n.e.c.	18.0		14	
Manufacturing total	**32.2**	**37.5**	**2874**	**3095**
Electricity, gas and water supply, construction	2.0		4	
Trade, repair, hotels and restaurants	46.7		304	530
Finance, insurance, real estate, business act.	25.4	32.6	771	1491
Other activities	10.5		87	
Total Business Enterprise	**29.6**	**35.4**	**4104**	**5622**

Source: Statistics Canada, data extracted on 12 Oct 2010 from OECD.Stat

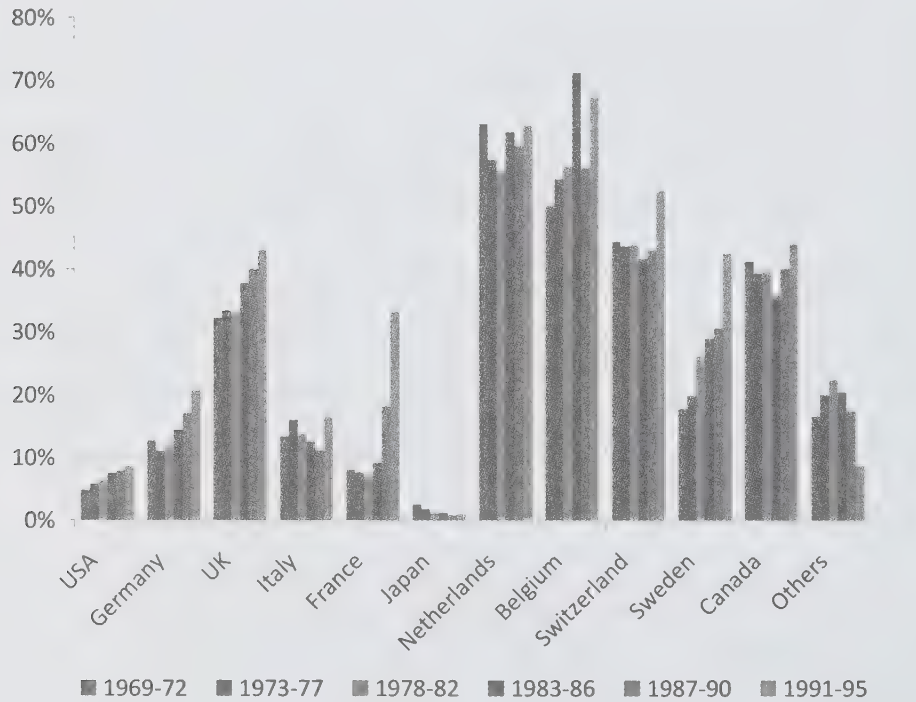
Using patent data

There is an alternative to R&D data that is able to give a picture of cross border activity over a longer period, and that is patent data. In most patent jurisdictions of the world, patent applications contain the geographic location of the inventor, as well as the name of the firm that owns the invention (if there is one). Thus it is possible to know both the location of the inventive activity, and the location of the owner of its output. Pioneering work by Cantwell and co-authors (Cantwell, 1989; Cantwell and Janne, 1997) has used U.S. patenting data in this way.

I show an example of the results from Cantwell and Janne in Figure 6; unfortunately the data in this figure go through 1995 only. These data show levels and trends that are similar to what we know from the R&D and other data, but in somewhat more detail. First, the countries with a substantial patenting presence by foreign-owned firms are the small outward-oriented economies of the Netherlands, Belgium, and Switzerland, where the foreign share is above 50 percent, followed closely by two with a strong US presence among their R&D performers, Canada and the UK. Second, most of the countries show a significant increase in foreign presence during the latest period (1991-95), and a few show a steady increase between 1970 and 1995 (the US, Germany, the UK, and Sweden).

Guellec and van Pottelsberghe (2001) use EPO and USPTO data from 1993-95 to look at the shares of patents owned by foreigners but invented domestically (SHIA) and the share invented abroad but owned domestically (SHAI), both as a share of domestic patenting. Their figures show that foreigners own 24 per cent of EPO (resp. 21 percent of US) patents applied for from Canada, and 15 percent of EPO (resp. 18 percent of US) of Canadian owned patents were invented abroad.

Figure 6: Share of US patents of the world's largest firms attributable to research in foreign locations, by nationality of parent firm



Source: Cantwell and Janne (1997)

These numbers seem to be roughly comparable to the R&D figures cited earlier. Using cross-country analysis, they find that Canada is more internationalized in patenting than would be predicted by country size and R&D intensity, as are the US and the UK.

Recently Harhoff and Thoma (2010) have produced a comprehensive study of R&D location based on patenting activity that updates and expands considerably the Cantwell and Janne study. The first difference from the earlier study is that they consolidate around 100,000 European entities into 1500 corporate groups, and also include 1500 US corporations. In addition, they use EPO and PCT patent applications from the Patstat database, which arguably focuses on more valuable and important applications from around the world. Finally, their data is for 1986 to 2008 and is fairly reliable up to 2005, so they can look at trends over 4 5-year periods from 1986 to 2005. By comparing the location of the inventor(s) on the patent applications and the location of the ultimate owner (firm), they are able to measure the extent to which invention is taking place outside the home country of the firm.

The novel feature of their work is that by regressing the R&D expenditure of the firm on the number of inventors in each location together with country, year, sector, and country-year dummies (thus controlling for overall changes in relative prices, the variable composition of R&D spending across sector and country, etc.) they are able to form an impression of the relative price of R&D labor in each country. It appears that inventors in the USA and Canada are the most expensive, although there are a number of caveats to the result. However, they do not disaggregate these numbers down to the country level, so the result is doubtless driven by the USA.

The raw data in Harhoff and Thoma (2010) shows that Canadian firms have been shifting some R&D abroad between the 1986-1990 period and the post-2000 period, mostly to Germany, the US, and to developing countries including China and India. For applicant firms from the US and the European countries with large amounts of R&D, the Canadian inventor share has not changed dramatically between 1986 and 2006, although Canadian invention by firms headquartered in France, Germany, Great Britain, and Sweden has grown as a share of those firms invention (Table 6). These figures do not suggest that Canada has lost out significantly in the race to attract global R&D.

Table 6: Canadian inventor share of foreign-owned invention around the world

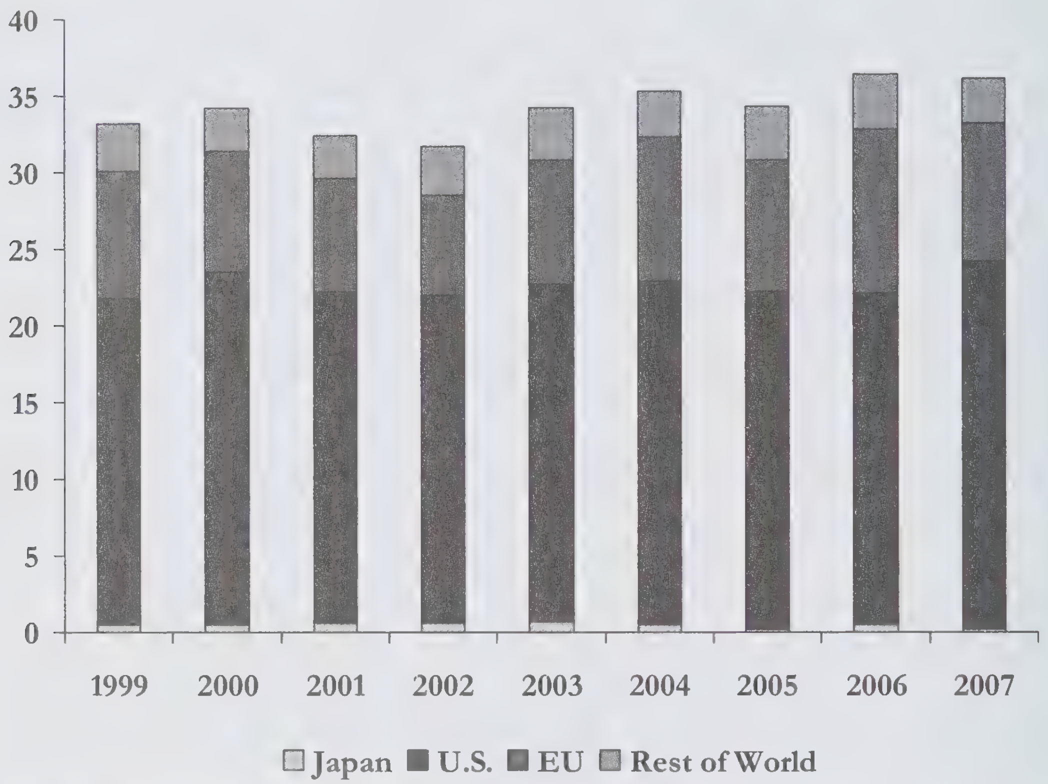
	1986-1990	1991-1995	1996-2000	2001-2006
Switzerland	0.5	0.4	0.7	0.7
Germany	0.3	0.6	0.8	0.9
France	1.1	1.3	1.6	2.0
Great Britain	0.6	0.9	1.4	1.5
Italy	0.6	0.6	0.9	0.7
Netherlands	0.3	0.3	0.4	0.3
other EU	0.5	0.3	0.8	0.8
Sweden	0.5	1.0	1.7	1.5
US	0.9	1.0	1.3	1.3

Source: Harhoff and Thoma (2010)
Top US and European R&D performers only

Another way to look at this issue using patent data is to ask what share of patents obtained by inventors located in Canada is owned by foreign corporations. The OECD (2010) provides such data via their Patstat project. Figure 7 shows the trends in the share

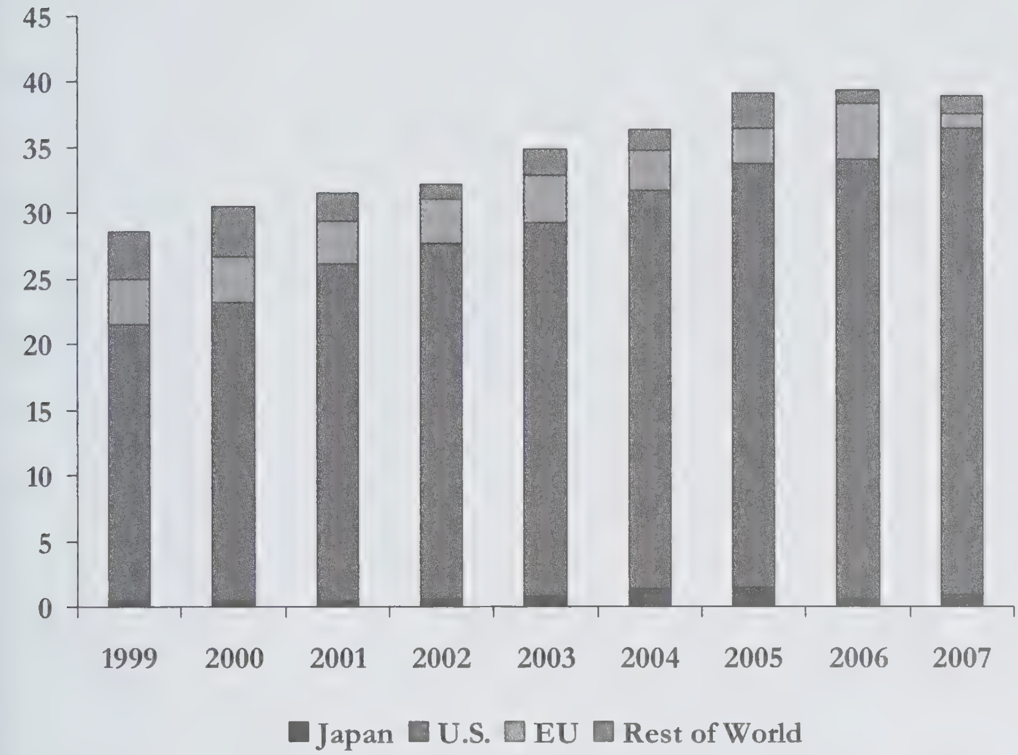
of Canadian PCT (Patent Cooperation Treaty) applications owned by foreigners from the US, the EU, Japan, and the rest of the world between 1999 and 2007. The shares are almost constant during this period, with a slight increase in US-owned patents. Figure 8, which is based on patent grants at the USPTO, confirms the modest trend toward US ownership of Canadian-origin patents. By itself, this suggests increased US investment in innovation in Canada relative to domestic investment. However, the data on US patent grants is seriously biased downward after about 2003 due to the application-grant lag, so the probable explanation for this finding is that US applicants have a shorter application-grant lag on average than applicants from other countries due to their proximity to the Patent Office and familiarity with its operations.

Figure 7. Share of Canadian patent applications under the PCT owned by foreigners



Source: http://stats.oecd.org/Index.aspx?DatasetCode=PATS_COOP

Figure 8. Share of Canadian patent grants under the USPTO owned by foreigners



Source: http://stats.oecd.org/Index.aspx?DatasetCode=PATS_COO

Looking in more detail at the patent data can also be enlightening. For example, di Minin and Palmberg (2007) examine the home and foreign patenting of four multinational wireless telephony firms (Ericsson, Motorola, Nokia, and Qualcomm) and find that the essential patents held by these firms are more likely than other patents to have originated in the firm's headquarters country. Essential patents are those defined by the European Telecommunications Standards Institute as essential to a telecommunication standard and these firms held 553 out of 834 such patents. The authors argue that the localization of essential patents occurs both because there is inertia in the organization of a firm's R&D and also because more strategic R&D is likely to be conducted at home.

Determinants of R&D location

The R&D location decision is the outcome of a complex decision-making process that depends on a number of factors. The first thing to note is that setting up an R&D lab in a new location is rarely accompanied by the closing of a lab elsewhere. That is, the decision to locate R&D in a foreign country is usually taken together with a decision to expand the R&D program or to redirect it in some way. It is generally far too costly in terms of the loss of firm-specific human capital to shut down a lab in one location and move the people and equipment to a different far away location. A survey of U.S. firms by Thursby and Thursby (2006) found that over 75% of the firms reported that the R&D facility they were considering locating in a new area was for expansion. Applying the term "footloose" to R&D, as some have done, is therefore a bit of hyperbole. The fact that most of the changes in foreign R&D investment come from the expansion of R&D programs means that changes in the worldwide distribution of R&D spending will inevitably be somewhat sluggish. The numbers in Table 3b support this conclusion.

When a firm considers whether to locate some or all of its R&D outside its home country, it weighs the costs and benefits of staying at home versus those from moving. These take many forms, both financial and non-financial, and I review them in this section of the paper.

Reasons for locating R&D in foreign countries vary considerably depending on the relative levels of (technological and economic) development of the investing and host countries. In choosing among developing countries, factors such as the size of the local market, local labor regulation and costs, the availability of at least some of the relevant scientific and technical expertise, and other local regulations such as IP enforcement and the security of property rights might be expected to matter. Past research has found that firms move R&D to less developed countries primarily based on the need to complement their sales and production activities taking place in those countries. Such R&D is used to tailor process innovation to local conditions, and to customize products for local demand. See, for example, Håkanson and Nobel (1993a), who use survey data and factor analysis to conclude that 37% of the 1987 foreign R&D employment of the top 20 Swedish multinationals is located for reasons of local production support and market proximity. Only 8% of the employment was motivated by a desire to access foreign R&D, and fully 34% was located in foreign countries for reasons labeled by the authors as "political". However, a closer look at the components of this factor reveals that that it includes cost advantages such as lower R&D labor cost and R&D subsidies in addition to pure political factors.

Odagiri and Yasuda (1996) look at overseas R&D conducted by Japanese firms during the 1980s and find similar results. Support for local marketing is an important motivation, especially in Asia, whereas access to advanced technological knowledge and R&D resources appears to be a more important motivation for R&D investment in the US and Europe. Keeping in mind that these results are for the 1980s, they are consistent with the traditional view that MNE R&D investment in developing economies is associated with technology exploitation while in developed economies it is more driven by exploration (technology augmenting) motives. Ito and Wakasugi (2007) revisit this topic using data on Japanese MNEs during the late 1990s, and find that such firms are more likely to establish standalone overseas R&D labs if they are more R&D-intensive in general and that they too locate such labs in countries with abundant R&D-related human capital (that is, developed countries). They also found that the strength of IPR in the host country was an important positive influence in location choice.

When locating R&D in developed economies at the same or even higher level of development, many of the factors listed for developing countries will also matter, of course. However, in addition to these factors, because it is inevitably more costly to operate R&D labs in more than one country, the location must provide features that are not easily attainable in the home location. Among these are the quality and specializations of local universities and research institutions (the available knowledge base), and the availability of scientists and engineers. Pearce (1999) and Pearce and Papanastassiou (1999) document a 1992/94 survey of the R&D laboratories of foreign MNEs in the UK. These laboratories mentioned development of a new product slightly less often than adaptation to local market conditions as their primary activity, but when such development was mentioned, it took primacy. That is, a large minority of such laboratories (34%) were focused on new rather than adaptive R&D.

Location choice can also be based on access to lead markets where diffusion of innovations is more easily achieved, and where the customer base is therefore more likely to contribute to the enhancement of a particular product. Such considerations are

especially important in network-based technologies, such as web innovations and end-user telecommunications equipment and may help to explain the large number of foreign R&D labs in the United States.

On the financial side, firms are sensitive to the tax treatment of their R&D spending. Is there an R&D tax credit available, and will they be able to take advantage of the credit even if they have no current taxable income? That these things can matter was shown by Bloom *et al.* (2002) using a panel of 9 OECD countries during the 1979-1997 period. They find a short run tax price elasticity of R&D with respect to its cost of 0.1 and a long run elasticity of unity, suggesting that every dollar the firm saves in R&D cost will be spent on more R&D in the country eventually, but not immediately.[7] A second feature of tax treatment that may matter is the tax treatment of technology royalties that are repatriated to the home country. Hines (1993, 1994) found that firms shifted R&D to a host country when the home country had higher tax rates on these royalties. That is, doing R&D in the host country was to some extent a substitute for R&D in the home country. However, it is worth mentioning that Thursby and Thursby (2006) found that taxes overall were very low on the list of things considered when locating a new R&D facility abroad.

A second financial consideration might be the national treatment with respect to tax credits and subsidies – are these available for foreign firms or only for domestic firms? Most countries seem to apply national treatment in the case of R&D tax credits, allowing them for domestic affiliates of foreign firms (KPMG, 1995). Exceptions are Canada, which refunds the credits to firms that do not pay taxes only if they are privately held domestic firms, and Australia, where the R&D tax credit is not available to branches of foreign firms in the country (Bell 1995). There are also special temporary tax reduction provisions for foreign R&D or knowledge workers available in countries such as Denmark, Belgium, and the Netherlands. Recently Belgium and the Netherlands have introduced special low tax treatment of income that can be attributed to patents, and the UK is projected to follow suit in 2013.[8] However, with the exception of Bloom *et al.* (2002), among the many studies of R&D location choice there almost none that include information on the tax treatment of R&D so we do not know for certain to what extent firms respond to these incentives.

There exist some surveys of multinational firms that ask them to rank the importance of various factors in locating their R&D abroad (Hakanson and Nobel, 1993; Florida, 1997; Kuemmerle 1999; Pearce and Papanastassiou 1999; Edler *et al.*, 2002). Unfortunately, the questions asked and categories used are rarely the same from survey to survey so precise comparison is difficult, but one can get a good overall picture of firm thinking from the results. One of the most informative is the previously mentioned survey done in the Spring and Fall of 2005 by Thursby and Thursby (2006) for the U. S. National Academies. They surveyed high-level R&D executives in over 200 multinational corporations, most of whom were headquartered in the U.S. or Western Europe.[9] The respondents ranked the drivers of location choice for R&D in the following order:

1. close to highly qualified R&D personnel

[7] See Hall and van Reenen (2000) for a survey of these kinds of estimates.

[8] It is not clear to what extent R&D will move across borders in response to reduced corporate tax rates on income attributable to patents. In fact, firms have considerable flexibility in where the accumulate income and in tracing it back to patent ownership, so that this tax instrument seems unlikely to lead to the movement of large amounts of R&D.

[9] 44% headquartered in the U.S.; 49% in Western Europe; 7% elsewhere in the world.

2. close to customers
3. research collaborations with other firms
4. close to universities
5. availability of sponsored university or other research organization research
6. internet-based searches for solutions to technical problems
7. close to competitors

There was little significant difference between the U.S. and Western European firm in these rankings, except that Western European firms rated closeness to universitie somewhat more highly, which may reflect a slight difference in industrial compositio (firms in Western Europe are more likely to be chemical or pharmaceutical firms).

The second part of their survey focused on the location of one of the firm's mos important proposed or recently established R&D facility, distinguishing between thos located in developed countries, and those located in emerging economies. Table 7 an Figure 9 summarize their results. For location in the home country and other develope countries, access to scientists and engineers, both as employees and at universities, alon with IP protection and ownership were clearly important factors. Although these factor also affected the choice of emerging economy location, in that case R&D costs and th size and expected growth of the market were more important. It is noteworthy that ta breaks, subsidies, and the absence of legal requirements were the least important factors i choosing a location, regardless of the development level.

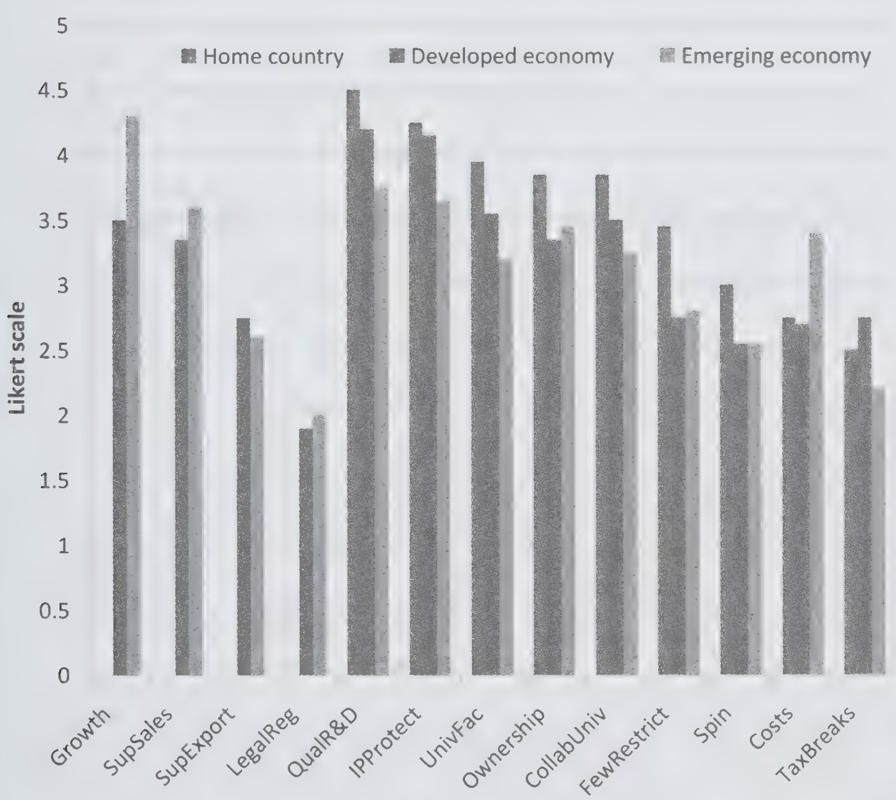
Since the early 1990s, as more and better data has become available, a large numbe of papers that study the R&D location decision empirically have appeared. Summaries o these papers are given in Table 6, which shows the period covered, the level and type o the analysis, the countries involved, and the factors that were identified as the mos important determinants. It is clear from the table that these studies are frequently ver non-comparable due to differences in the unit of observation and the variables considere However, many of them reach similar conclusions, so it is possible to draw some broa conclusions from this body of work.

Table 7: Factors considered important when locating an R&D facility

Factors	*Name*	*Home country*	*Developed economy*	*Emerging economy*
Country has high growth potential.	Growth	NA	3.5	4.3
The R&D facility was established to support sales to foreign customers.	SupSales	NA	3.35	3.6
The R&D facility was established to support production for export.	SupExport	NA	2.75	2.6
The establishment of an R&D facility was a regulatory or legal prerequisite for access to local mkt.	LegalReg	NA	1.9	2
There are highly qualified R&D personnel.	QualR&D	4.5	4.2	3.75
There is good IP protection.	IPProtect	4.25	4.15	3.65
There are university faculty with special scientific or engineering expertise.	UnivFac	3.95	3.55	3.2
It is easy to negotiate ownership of IP from research relationship.	Ownership	3.85	3.35	3.45
It is easy to collaborate with universities.	CollabUniv	3.85	3.5	3.25
There are few regulatory and/or research restrictions in this country.	FewRestrict	3.45	2.75	2.8
The cultural and regulatory environment is conducive to spinning off or spinning in new businesses.	Spin	3	2.55	2.55
Exclusive of tax breaks and direct govt assistance, the costs of R&D are low.	Costs	2.75	2.7	3.4
We were offered tax breaks and/or direct govt. assistance.	TaxBreaks	2.5	2.75	2.2

Source: Thursby and Thursby (2006), pp. 21-28.

Figure 9: Importance of factors in locating an R&D site



Source: Thursby and Thursby (2006)

The first dimension across which the studies vary is the nature of the data that they use: a few are based on specially conducted surveys (Hakanson and Nobel, 1993; Florida, 1997; Edler *et al.*, 2002; Thursby and Thursby, 2006), whereas others draw from R&D data collected by the OECD, the Japanese statistical agency, or the US Bureau of Economic Analysis. In some cases the authors have access to firm-level data, whereas in other they rely on industry or country level data (Kumar, 1996, 2001; Jones and Teegen, 2003; Hegde and Hicks, 2008; Erken and Kleijn, 2010). Because patent data are publicly available at the firm and location level (unlike R&D), a number of studies make use of these data to analyze the location decision for innovative activity (Patel and Vega, 1999; Guellec and van Pottelsberghe, 2001; Le Bas and Sierra, 2002; Cantwell and Piscitello, 2002; Criscuolo *et al.*, 2005).

The second main source of variation is that some studies focus on the choice of host country given a foreign location for R&D (Kumar 1996, 2001; Cantwell and Piscitello, 2002; Belderbos *et al.*, 2008: Hegde and Hicks, 2008; Shimizutani and Todo, 2008; Schmiele 2009; Dachs and Pyka, 2010; Erken and Kleijn, 2010) whereas others look only at the decision to perform R&D outside the home country (Edler *et al.*, 2002; von Zedtwitz and Gassmann, 2002; Belderbos *et al.*, 2009). The home countries considered range from individual (US, Japan, Sweden) to the Triad, the OECD, or more. Thus the source of variability in studying the location decision can be variation across destination country, variation across source country, or both. However, the only study that really looks at a number of source and destination countries at the same time is the patent citation study by Criscuolo *et al.* (2005).

What do these studies find? Patel and Vega (1999) propose a useful taxonomy based on revealed technical advantage as shown by patents to classify the strategies followed by firms that locate their R&D in another country. There are four strategies, depending on whether the firm has revealed technical advantage (RTA) in the home and/or host country: 1) technology seeking (the host is strong in the area and the firm is weak); 2) home base technology exploiting (the host is weak in the area and the firm is strong); 3) home base technology augmenting (the host and the firm are both strong in the area; and 4) market seeking (non-technology motivated, both are weak in the area). Both these authors and LeBas and Sierra (2002) find that strategies 2 and 3 are by far the most common, which essentially means that firms with an RTA in a particular technology at home will tend to locate R&D in other countries, regardless of whether those countries have any particular advantage in the technology. Home technology exploiting can be viewed as a demand driven strategy, in the sense that the firm is doing R&D in a location which has need for its technology, whereas home technology augmenting is driven more by the need to acquire knowledge from producers of related technology, that is, more supply driven.

The empirical results in the various papers strongly support this view: the variables that most strongly affect location choice are invariably the size of the market, the R&D intensity of the host country, the availability of technical and educated workers, and the presence of lead customers. The sales of the relevant foreign affiliate are also a strong predictor of R&D, where they can be included (when the variability is across firms or host countries). Thus demand considerations (the available market and the need to support local sales) and access to R&D and R&D personnel are the overriding considerations, as suggested by Thursby and Thursby (2006). It is noteworthy that the cost of R&D (usually measured as wages of R&D personnel) rarely enters the regressions significantly, and sometimes enters with the wrong sign. In addition, as mentioned earlier, few of the papers consider the tax costs of R&D as an influence on the location decision.

A couple of the papers are able to look at research and development separately. Von Zedtwitz and Gassman (2002) have aggregate foreign R&D for 81 multinationals in OECD countries broken down by R and D. They find that research depends on the presence of universities and innovation centers, access to R&D personnel, and the availability of subsidies, whereas development is more associated with supporting sales, the presence of lead customers, and costs. Thus there is a clear separation here between technological opportunity, which drives the research location choice, and demand, which drives development. On the other hand, Shimizutani and Todo (2008) look at 12,000 subsidiaries of Japanese MNEs, and find that foreign sales and market size drive both research and development, whereas foreign R&D intensity attracts research and home country R&D intensity makes development in a foreign location more likely. So in this case, although foreign R&D is an attractor for research, demand factors affect both types of R&D.

International R&D spillovers

R&D performed in countries outside a firm's headquarters country is assumed to generate and benefit from knowledge spillovers. First, the knowledge generated by this R&D is likely to spill over to some of the local firms. This is especially the case when the firm investing comes from a frontier country and the local firms are technological laggards but not by too much. That is, some local absorptive capacity is necessary. Second, the very reason why the firm chooses to locate its R&D where it does may be to benefit from specialized local knowledge in the form of a particular science base, university research that is strong in a certain area, or even local competitors from whom it can learn. This section of the paper assesses the empirical evidence on the presence of international R&D spillovers, that is, spillovers from R&D done in one country on productivity in another country, under the presumption that one of the channels for these spillovers is the presence of foreign R&D in the host country.

Conceptually it is useful to distinguish two kinds of spillovers: rent spillovers and knowledge spillovers (Griliches, 1992). The first type occurs when a firm or consumer purchases R&D-incorporated goods or services at prices that do not reflect their user value, because of imperfect price discrimination due to asymmetric information and transaction costs, imperfect appropriability and imitation, or mismeasurement of the true value of the transaction due to the lack of hedonic prices. The more competitive are markets, the less ability firms have to appropriate the benefits of their R&D and the more pecuniary spillovers will take place. By contrast, the more prices are corrected for quality improvements, the less we should observe spurious R&D spillovers.

The second type of spillover occurs when an R&D project produces knowledge that can be useful to another firm in doing its own research. Knowledge is a rival and only partially excludable good. Because of weak or incomplete patent protection, inability to keep innovations secret, reverse engineering and imitation, some of the knowledge and benefits from R&D are not kept within the firm. The more knowledge is codified and the higher is the absorptive capacity of other firms, the more knowledge spillover will take place.

Table 8: The determinants of R&D location - literature survey

Authors	*Date of paper*	*Overview*	*Type*	*Dates covered*	*Home country*	*Unit of observation*	*Sample*	*Factors (in order of importance)*
Hakanson and Nobel	1993	23% of Swedish R&D abroad - what are the reasons?	data	1987	Sweden	subsidiary in a foreign country	20 Swedish MNEs (170 foreign subs)	(1) support to local production (5%) (2) market proximity (32%); (3) foreign R&D access (8%); (4) political factors (34%)
Kumar	1996	location determinants for US MNE R&D using aggregate data	emetrics	1977, 1982, 1989	US	foreign country - agg US R&D	US MNEs at agg level (28 countries)	mktsize, R&D intensity, phones (neg), IP (RR index,OECD only), tariff bar (weak, dev only), res pat (dev only)
Florida	1997	globalization of innovation and FDI in R&D - motivations	survey/ data	1994	many	foreign lab in US	207 standalone foreign R&D labs in US	order of importance: biotech, electronics, chem/mat, auto access to tech talent; then links with US S&T; customization & R&D less impt
Patel and Vega	1999	determinants of foreign location of US patenting	patent data analysis	1969-1996	Triad	product group within MNE	220 Triad MNEs	strategies: 1 tech-seeking; 2 home base exploiting; 3 home base augmenting 4 mkt seeking. 2&3 by far the most impt
Kumar	2001	determinants of overseas R&D location & spending level by US and Japanese MNEs	emetrics	1982, 1989, 1994	US; Japan	home country-industry-host country	agg US & Jpn MNEs at 7- ind level investing in 74 countries	US: mktsize, S&E or R&D intensity, EU, not pat, open, local sales US->dev: mktsize, S&E or R&D intensity, not pat, open, local sales JP: mktsize, R&D cost, not pat, open, local sales, R&D intensity JP->dev: mktsize, R&D cost, R&D intensity, patents, not open, local sales
Edler et al.	2002	surveyed R&D strategy in general incl internationalization	survey	1998	Triad	agg external R&D by home country	2009 Triad MNEs	adapt to local req, R&D personnel, lead mkts customers.
von Zedtwitz & Gassmann	2002	Development globally dispersed, research concentrated in 5 regions why?	survey/ data	1998	OECD	agg external R&D by MNE	81 MNEs (US, EU, JP, KR)	Research: univ, R&D personnel, centers of innov, subsidies, support local dev Development: support sales, lead customers, cost
Le Bas and Sierra	2002	Determinants of foreign location of EPO patenting	patent data analysis	1988-1990 1994-1996	OECD	ext pats by tech groups for each MNE	350 MNEs	strategies: 1 tech-seeking; 2 home base exploiting; 3 home base augmenting 4 mkt seeking. 2&3 by far the most impt

Table 8 Cont... The determinants of R&D location - literature survey

Cantwell and Piscitello	2002	relative attractiveness of Italy, Germany and UK for foreign-owned tech development using US patent data	emetrics/patents	1969-1995	many	agg foreign US pats by host country by tech field	784 largest worldwide patenting firms at regional level in UK Italy Germany	local mktsize in Germany, external sources of K (intensity & education), breadth of tech specialisat in region; ind specific and cluster-based spillovers Italy and UK but not in Germany (crowding out)
Jones & Teegen	2003	investigate motivations for US MNEs to locate R&D in foreign locations	emetrics	1994	US	host country	agg country-level R&D by US MNEs	affiliate sales, education; R&D cost and S&Es do enter (small sample)
Criscuolo et al.	2005	EPO citations by US and EU MNEs to home & host country patents	emetrics/patent citations	1977-1999	US/EU	host country by home country by industry	118 US & EU MNEs	EU firms - cite rates same except for pharma - mo exploiting than augmenting US firms - cite US more than EU, more exploit tha augment
Thursby & Thursby	2006	survey of reasons for choosing an R&D location	survey	2005	US/EU	MNE	US & EU MNEs	OECD econ: R&D personnel, IP protect, univ, gro support sales, IP ownership Dev econ: growth, R&D personnel, support sales, protect, IP ownership, costs, univ
Hegde & Hicks	2008	explain location of US mne R&D and US patents using host country info	emetrics	1991-2002	US	host country by tech class	US MNEs at ind level	R&D: foreign sales, foreign S&E pubs, Europe, chemicals patents: foreign sales, foreign patents, foreign S& pubs, electrical, other, chemicals, Europe
Shimizutani & Todo	2008	determinants of location for basic/app research and development by subs of Japanese firms	emetrics	1996-2001	Japan	subsidiary in a foreign country	12,466 JP subsidiaries of MNEs	Research: foreign sales, age of sub, mktsize, fore R&D intensity, R&D cost Development: parent R&D intensity, foreign sales age of sub, mktsize
Belderbos et al.	2009	What determines Japanese firm inv in US & Japan? Separate R from D	emetrics	1996	Japan	MNE by for/dom R&D	146 Japanese MNEs	relative R&D home/away depends on ind-specific growth in patents for R (tech oppty); ind-specific demand & prod growth for D
Schmiele	2009	What determines overseas innovative activity by German firms	emetrics/CIS	2004-2006	Germany	host country by firm	1439 German firms	exporting, R&D-doer, innov coop with intl, lack of info at home, high cost at home, size, IP user for or new process abroad
Dachs & Pyka	2010	Determinants of cross-border patenting	emetrics/patents	2000-2005	EU	home country by host country	EU patenting firms	GDP & R&D in home & host countries, distance (neg), common language, both EU15, IPR relative dev level
Erken & Kleijn	2010	What determines where MNEs locate R&D in the developing world? Looks at inward R&D in 13 countries	emetrics	1990-2002 1981-2001	OECD	host country	R&D: panel of 13 countries Patents: 21 OECD countries	inward R&D: foreign VA/GDP, private R&D intens IPR (-), R&D cost (+), S&Es & public R&D do not except for high tech sectors pats per labor: GDP growth, private R&D intensity education, pub R&D & wages weak

Abbreviations:

dev = developing countries; OECD = developed countries; R = basic/applied research; D = development; MNE = multinational; S&E = scientists and engin

foreign

Source: Hall, Mairesse, and Mohnen (2010)

It is important here to distinguish between spillovers and some kinds of technology transfer. Technology transfer usually refers to trade in technology, which occurs when an agent sells a piece of technology with a price attached to the transaction. A non-pecuniary spillover, on the contrary, refers to an unintended transfer of knowledge, in which no payment is involved.

One of the important questions about R&D spillovers is the extent to which they are localized to an urban area, region, or even country. Presumably the desire to benefit from such localization is a driver of the globalization of R&D. Recent surveys by Feldman and Kogler (2010) and Autant-Bernard, Mairesse, and Massard (2007) review the evidence on this question.[10] Feldman and Kogler summarize the known stylized facts about the geography of innovation in the following way: innovation is spatially concentrated and geography provides a platform for the organization of economic activity. Knowledge spillovers are nuanced, subtle, pervasive, and not easily amenable to measurement, and tend to be geographically localized. The local presence of universities is necessary but not sufficient for innovation. Finally, innovative locations tend to develop over time via an evolutionary process.

Measuring spillovers[11]

Econometric estimates of the importance of spillovers are obtained by adding a measure of external R&D to a standard production or cost function framework that also includes internal R&D as an input. The R&D spillover variable is measured as a weighted sum of the R&D stocks from sources outside of the firm:

$$S_{it} = \sum\nolimits_{j \neq i} a_{ji} R_{jt}$$

where the a_{jt} weights are proportional to some flows or proximity measures between firm, industry, or country i, the receiver of R&D spillover, and firm, industry, or country j, the source of R&D spillover. In the case of international spillovers, the unit of observation is sometimes a country and sometimes an industry within a country. Only rarely is it a firm within the country.

Various flow related weights have been used in the literature: intermediate input transactions (Terleckyj, 1980), investments in capital goods (Sveikauskas, 1981), hiring of R&D personnel, attendance at workshops, seminars or trade fairs, collaborations, adoption of new technologies, flows of patents (Scherer, 1984) or innovations (Sterlacchini, 1989) from industry of origin to industry of use, and patent citations. The intuition is that the more j trades with i, invests in i, collaborates with i or gets cited by i, the more it is likely to diffuse its knowledge to i. Spillovers can also be measured independently of any economic transaction simply on the basis of proximities in various types of space. These proximities can be uncentered correlation coefficients between

[10] For surveys on R&D spillovers in general, see Griliches (1992), Hall *et al.* (2010), and Mohnen (1996); on international R&D spillovers in particular, see Branstetter (1998), Cincera and van Pottelsberghe de la Potterie (2001), and Mohnen (1998).

[11] This and the following section are based on Hall *et al.* (2010).

positions in patent classes (Jaffe, 1986), fields of research (Adams and Jaffe, 1996), qualifications of personnel (Adams, 1990) or lines of business.

Measures of proximity that are independent of any economic transactions are expected to capture pure knowledge spillovers. Rent spillovers, in contrast, are likely to occur whenever monetary transactions take place, i.e. with trade, direct investment, technology payments, hiring of workers, research collaborations, and mergers and acquisitions. In practice the two types of spillover are hard to dissociate, because, on the one hand, knowledge flows are often concomitant with user-producer transactions and the capture of rents, and on the other hand, knowledge gains can be used to reap economic rents.

The measured R&D spillover term is introduced into an extended Cobb-Douglas production function along with the stock of own R&D:

$$Q_{it} = f(X_{it}, R_{it}, S_{it}, T_{it}, \varepsilon_{it})$$

where Q_{it} is output, X_{it} are the conventional inputs, R_{it} denotes the own stock of Research and Development (R&D), a proxy for the stock of knowledge, T_{it} is an index of technological change and ε_{it} is a random error term. The return from outside R&D is then estimated as the marginal effect of S_{it}, which represents an elasticity or a marginal productivity depending on the chosen functional form of the production function.

Empirical evidence

International R&D spillovers are transmitted through the same channels as those documented in the literature on technology transfer: international trade in final goods, intermediate inputs, capital goods, b) foreign direct investment (FDI), especially if it comes with manpower training to operate the new machines and to assimilate new production and management techniques, c) migration of scientists, engineers, educated people in general, or their attendance at workshops, seminars, trade fairs and the like, d) publications in technical journals and scientific papers, referencing other publications, invention revelations through patenting, patent citations, e) international research collaborations or international mergers and acquisitions, f) foreign technology payments, i.e. royalties on copyrights and trademarks, licensing fees, the purchase of patents, the payments for consulting services and the financing of R&D conducted abroad.

A highly cited study of the impact of international R&D spillovers on TFP was conducted by Coe and Helpman (1995). In this study, conducted for 22 developed countries, they used the share of imports from the sending country as weights to aggregate the R&D, confining the possible set of sending countries to the G-7 economies (Canada, France, Germany, Italy, Japan, the UK, and the US). They were able to estimate the own rate of return to R&D as 123% for the G-7, and 85% for the other 15 countries, and the spillover return from the G-7 as 32%, implying that roughly a quarter of the benefits from R&D in G-7 countries accrues to their trading partners.

(Coe *et al.* 1997, 2009). Keller (1997) cast doubt on the trade-related interpretation of Coe and Helpman's R&D spillover by showing that significant foreign R&D spillovers can be obtained when the weights in the construction of the spillover are random rather than based on import shares. This result suggests that the important identifying variation was in the total amount of external R&D rather than being mediated by trade. Lichtenberg and van Pottelsberghe (1998) critique Coe and Helpman's weighting of the foreign R&D

stocks by means of the proportion of total imports originating from the foreign R&D sources for being too sensitive to the aggregation of the data and propose instead to normalize the imports from the recipient country by the GDP of the sending country. van Pottelsberghe and Lichtenberg (2001) provide evidence for outward FDI as another channel of international R&D spillovers. Kao, Chiang and Chen (1999) find cointegration between the TFP and R&D variables, using cointegration tests that are appropriate for panel data. When they re-estimate the Coe and Helpman specification with a dynamic ordinary least squares (DOLS) estimator (which is not biased in small samples, unlike the ordinary estimator) they no longer obtain a significant effect for the trade-related foreign R&D spillover, although the domestic R&D impact is essentially unchanged.

The relative importance of domestic and foreign R&D contributions to total factor productivity growth depends on the channels of transmission used to estimate foreign R&D spillovers, but all channels combined it is likely that small R&D spenders have relatively more to gain from foreign R&D than big R&D spenders by the sheer size of the absorbable knowledge. It depends of course on the absorption capacity of the receiver and her openness to transmission channels, and therefore the output elasticity to foreign R&D may be higher or lower than the output elasticity of domestic R&D (as shown by van Pottelsberghe and Lichtenberg, 2001).

Table 5 of Hall *et al.* (2010) surveys the econometric literature that estimates the social returns to R&D, and the last panel of that table presents results based on country data, shown here as Table 8. The estimates for the additional rate of return from (unpriced) spillovers to the rest of the world for R&D done in the G-7 economies are typically around 30 per cent, although there is some doubt about the robustness of the results given that they are obtained using aggregate time series data. The weighting matrix used is usually imports from the R&D-performing country to the recipient country. When Mohnen (1992b) simply uses aggregate foreign R&D stocks (unweighted), he obtains a return of 4 to 18 per cent. The main conclusion from the body of work is that R&D done elsewhere does generate spillover benefits for a country, which makes the management of a single country's R&D policy a bit more complex.

Conclusions and discussion

Is Canada losing out in the global R&D race? The evidence for this is not particularly strong. Like all developed economies, including the United States, the Canadian share of the world economy has shrunk slightly during the past ten years as the share of the BRICs and other emerging countries has grown. So like the rest of the OECD economies with the possible exception of the US and Japan, Canada's R&D appears rather stagnant. However it does not seem to be true that it is a less favored location for R&D than the rest of the OECD. It is simply the case that new R&D labs are generally being located in countries that are perceived to have high potential growth rates (and therefore increasing market size) and an increasingly well-educated science and engineering labor force. But this is the same situation faced by all OECD economies, not just Canada.

What are the implications for a country like Canada? Is it helpful to compare it to Sweden? Norway? Australia? That is, to developed economies rich in natural resources with relatively low population densities? As a primarily English-speaking country, Canada is different from the Scandinavian countries in one important dimension, which is reflected in the country's relatively high participation in international R&D activity, given its size. Like Ireland, Australia, and the UK, it has been an attractive destination for R&D in the past, although it appears from the OECD data that such investment has grown only

moderately during the 2000s. Data from US R&D investment abroad also suggests that investment in Canada has declined slightly between 2003 and 2007 relative the size of its economy, or relative to developing countries. Thus we can say for certain that inward R&D to Canada does not appear to be growing much at all, although the various data problems are such that we cannot conclude that it has declined.

Bernstein and Yan (1997) and Mohnen and Lepine (1991), among others, have documented the beneficial spillover effects of R&D conducted in other countries (Japan and the US, in particular) on Canadian productivity. It is likely that these spillovers would be even stronger if such R&D were conducted in Canada by foreign firms, for reasons of proximity.

It is natural to ask what the source of the apparent stagnation in overseas R&D investment in Canada is. The evidence on location choice emphasizes both supply side and demand side factors as important determinants of R&D location for developed countries. On the supply side are the role of highly qualified R&D personnel and university faculty along with good IP protection. There is no reason to think that these factors have deteriorated enough to cause a decline in absolute Canadian attractiveness; however, it is possible that the supply of R&D personnel in the emerging economies has been increasing, leading to a relative decline in the demand for Canadian researchers. On the demand side, we have the destination market size and its expected growth. This seems a much more likely source of the slight shift in R&D investment away from developed towards developing countries, and can explain the relative stagnation of inward R&D in Canada.

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Valuing Headquarters (HQs): Analysis of the Role, Value and Benefit of HQs in Global Value Chains

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Introduction

This report explores the growing importance of corporate headquarters in a world of global value chains. It examines the real and purported benefits of hosting corporate headquarters, and recent trends in location and operation of headquarters around the world and in Canada. It concludes with suggestions as to how governments may encourage headquarters to locate in Canada.

Governments around the world are keen to attract headquarters to their jurisdictions for a variety of reasons. Because of the nature of the headquarters function, headquarters typically employ highly-skilled and well-compensated professionals. Headquarters also purchase high-end professional services, notably auditing, management consulting and financial services, as they pursue their corporate mandate. Individuals in these high-end professional services roles are highly coveted by governments as high-end tax payers and consumers within the localities where they work. Their positive economic impact is compounded by the fact that a variety of services jobs are seen to grow up around them, thereby generating significant indirect economic benefits to the localities in which they work. As an added benefit, high-end professionals are also seen as being individuals who are likely to invest substantial time and resources in community development, philanthropy and good works.

Most importantly, for this study, headquarters are the preeminent decision-making centres within corporations, typically determining how corporate resources are allocated. Given the market significance of corporate resource allocation decisions, some analysts argue that a nation's economic welfare is directly tied to its ability to attract and retain corporate headquarters. This belief, which has been popular for at least 50 years, has been given further recent impetus with the emergence of global value chains.

Rise of Corporate Headquarters

The phenomenon of corporate headquarters precedes the rise of global value chains.

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During the twentieth century, large diversified corporations emerged as the most powerful players in economic affairs. Today, such corporations account for up to 60 per cent of output in advanced developed countries[1] As corporations grew, they became more complex. To deal with complexity, corporations began to divide themselves into divisions that specialized in specific areas of the corporation's product and geographic portfolio. Over time, the managerial functions of the corporation were separated from the operating divisions, resulting in the creation of a headquarters as a specialized entity dedicated to the management of the corporate portfolio, physically separate from places of production.

Growth of Global Value Chains

The term "global value chain" refers to the geographic dispersal of the corporate value-added process. A good goes through a series of transformations before it reaches the final customer. Each transformation adds value to the good. For instance, raw logs are harvested, transported, sawed, transported again, then lathed, sanded and stained before being assembled as furniture. Each of the stages adds value to the raw logs as they become more refined and turned into something useful for consumers. That is the corporate value-added process. The "global" refers to the modern tendency for multiple countries to be part of these processes. Multi-country production processes have been greatly facilitated by the steady decline in trade barriers between countries and the declining costs of transportation and communication.

In the past, countries gradually moved through stages of increased integration, beginning with trade in final goods between countries based on absolute advantage; to trade in final goods based on comparative advantage; to trade in unfinished goods in mid-production processes based on comparative advantage (e.g. Canada-United States Auto Pact); to trade of unfinished goods on a global basis based on comparative advantage. In this evolution, global investment and trade have become increasingly intertwined and trade has become increasingly intra-firm as well as inter-firm. This evolution has substantially been engineered by managerial decisions made in corporate headquarters.

According to Statistics Canada, there are 2 million registered businesses in Canada. This includes all types of businesses. Yet Canada has only slightly more than 3,000 headquarters, as defined by Statistics Canada[2] As explained below, the great majority of these headquarters belong to large enterprises with at least $75 million in annual revenues (Canada has roughly three thousand of these enterprises).[3] Given that very large enterprises often maintain multiple headquarters (for instance, subordinate headquarters in addition to a corporate headquarters) it is very likely that most of the headquarters in Canada belong to very large organizations, most of which have over $500 million in annual revenues.[4] Significantly, these are the sort of enterprises with the geographic and operational scope to operate their own global value chains and to participate in other companies' global value chains. As such, there is a natural affinity between corporate headquarters and global value chains.

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[1] Collis, Young and Goold, "The Size, Structure and Performance", p.3.

[2] Custom run, Statistics Canada Business Registry. Statistic Canada actually refers to headquarters as "head offices". The "head office" terminology is British terminology. This report uses the term "headquarters", which is of American extraction. They are conceptually the same thing. See below, Box 1, p.4 for a discussion of the term "headquarters".

[3] Statistics Canada, *Corporations Returns Act*, p.12.

[4] Ibid. In 2006, the mean revenue for large Canadian controlled corporations was $531 million.

Method

This report is based on a number of sources. It draws heavily on special runs of Statistics Canada's Business Register to track trends in Canadian headquarters. These data are compared to data from other international headquarter sources. We have conducted a comprehensive review of the relevant literature. (Although the global value chains concept brings together the trade and foreign investment literatures, these are largely separate from the organizational design literature.) These literatures are linked together in our analysis of how corporate design relates to global value chains. Finally, these sources are supplemented by interviews with executives from a number of large Canadian companies with significant headquarters in Canada.

Concepts

What is a Headquarters?

A headquarters is a corporate unit that performs administrative and managerial functions at a location that is geographically separated from the corporation's production units. Although separateness from a "production unit" is what defines a headquarters, it does not specifically address the aspect of a headquarters which concerns us most: the power of the headquarters unit to make decisions (i.e. is it the corporate or subordinate headquarters), the nature of the enterprise, its breadth of geographical operations, and the types of decisions it takes (is it a local business or a global enterprise).

Headquarters are always functionally and very frequently geographically separated from other corporate facilities. One reason for this separateness is symbolic. Theoretically, a large corporation rationally and dispassionately manages a portfolio of assets to maximize corporate value to shareholders. For instance, in 2001, when The Boeing Company decided to move its thousand-person headquarters from Seattle to Chicago, its Chair and CEO, Phil Condit, suggested that the move was, in part, motivated by a desire to separate the headquarters from operations: "As we've grown, we have determined that our headquarters needs to be in a location central to all our operating units, customers and the financial community—but separate from our existing operations"[5]. This suggests that the headquarters is often seen as the common linking mechanism between a company's production capabilities, its customers and the financial community that provides it with capital.

Headquarters exist to add corporate value beyond that which is added by corporate divisions or business units. That value is related to several functions. The first is to exploit economies of scale in managerial functions and in raising capital. For public companies, the capital raising function often involves share issuance, which leads to a further headquarters function; corporate governance. Corporate governance entails fiduciary responsibilities to shareholders that involve legal obligations to report on corporate activities and to control corporate finances.

Beyond capital-raising, corporations also exploit economies of scale by pooling functional resources at their headquarters. A "shared service" model is employed whereby headquarters provide business units with corporate services. These services, in areas such as human resources, tax, marketing, finance and treasury, may be charged back to the

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[5] CNN Money. "Boeing to Fly From Seattle".

business units. Finally, there are managerial efficiencies realized through senior executives working in a common location, which make it easier and quicker for them to communicate and discuss strategy and take collective decisions.

There are a great many permutations to headquarters design. Larger firms often have multiple centers of management and thus have multiple headquarters. In such cases there is usually a corporate headquarters where the CEO and direct reports of the 'C-Level' or 'C-Suite' are based, and one or more subordinate headquarters. For instance Stauss-Kahn and Vives found, in a sample of 21,000 US headquarters, that an average firm had 15 headquarters, so defined.[6] Depending on the type of product/service on offer, firm strategy and management philosophy, these headquarters vary in terms of function, location and size. Moreover, headquarter configurations also vary in terms of the relationship between the corporate headquarters and subordinate headquarters and, indeed, the relationship between subordinate headquarters.

Box 1. Defining Headquarters

At a base statistical level, a headquarters is simply a geographically separate unit whose sole purpose is to manage a corporation. There are significant qualitative differences between headquarters depending on their decision making role in the corporation.

For the purposes of this report, *corporate headquarters* refers to the chief decision-making centre of the corporation that houses the CEO and C-level executives who report directly to the CEO. These executives are typically provided a direct mandate from the board of directors, representing the shareholders, to set strategy for the organization and to run the corporation on a day-to-day basis. This level will typically have the most discretion in deciding on corporate supply chains. In this report, we call other headquarters *subordinate headquarters* in as much as they are subordinate to the corporate headquarters and do not have a direct mandate from the shareholders.

This is not to suggest that subordinate headquarters may not have very significant responsibilities, but these responsibilities are determined by the corporate headquarters and may change based on corporate headquarters decisions. Moreover, in complicated corporate structures the distinctions between the corporate and subordinate headquarters may blur because a corporation may choose to establish a subsidiary with its own C-level executives and board of directors. In the final analysis, the main issue is whether a headquarters is a significant part of the corporate decision-making apparatus and whether it is engaged in the value-adding processes of the corporation.

That decision-making authority and corporate engagement is not easy to discern from the mere the existence of a headquarters or even the title of its senior executives. For instance, a company may choose to appoint a "President" for Canada as a sort of figurehead for the Canadian market. Another company may only have Vice-Presidents or even Directors in Canada but these executives may be part of business units that cut across national boundaries. The result is that these "lower" level executives, in fact, have more actual decision-making power than a titular "President".

[6] Strauss-Kahn and Vives, "Why and Where Do Headquarters Move?" p.169.

Harzing has made a noteworthy attempt to organize the different types of headquarter configurations into a typology based on earlier work by Bartlett and Ghoshal.[7] The core Harzing typology attempts to classify different kinds of multinational corporations. In the table, below, we modify the Harzing typology to include a further category, that of the large domestic organization. In Canada, that includes large domestically-regulated companies with limited foreign competition, such as banks and telecommunication companies.

Harzing distinguishes between three types of multinationals: multi-domestic, global and transnational. The multi-domestic allows subordinates the most discretion to implement corporate mandates apart from the corporate headquarters. The global corporation is more centrally orientated and the corporate headquarters is much more directive that is the multi-domestic. A global corporation's subsidiaries tend to receive close direction from the corporate headquarters. Transnational corporations are a blend of multi-domestic and global. They will leave subsidiaries with more discretion, often because national regulatory structures require a beefed up corporate presence. For instance natural gas processing would appear to lend itself to a global structure similar to oil processing. But the distribution of natural gas is typically a highly regulated industry that involves a significant local corporate presence with expert understanding of the domestic legal and regulatory frameworks in effective in that country or location. That type of firm will favour a transnational structure that combines national presence with global scale. Meanwhile, the domestic corporation typically operates rather like the global corporation, where the "globe" is one country split into by market regions and/or production centres.

Table 1: Harzing's Typology, Modified to Include Large Domestic Companies

Parameter	Domestic	Multi-domestic	Global	Transnational
Organizational design				
Decentralized federation	Low	High	Low	Low
Network structure	Low	Low	Low	High
Inter-subordinate flows	Medium	Low	Low	High
HQ's pipeline	High	Low	High	Low/ medium
Centre of excellence	High	Low	Low	High
Local responsiveness				
Local production	Low	High	Low	Medium
Local R&D	Low	High	Low	Medium
Product modification	Low	High	Low	High
Adaptation of marketing	Low	High	Low/medium	High
Interdependence				
Total level of interdependence	Medium	Low	High	High
Level of HQ dependence	High	Low	High	Medium
Level of subordinate dependence	Low	Low	Low	High

Source: Anne-Wil Harzing, "An Empirical Analysis and Extension of the Bartlett and Ghoshal Typology of Multinational Companies"; The Conference Board of Canada.

[7] Anne-Wil Harzing "An Empirical Analysis and Extension of the Bartlett and Ghoshal Typology of Multinational Companies."

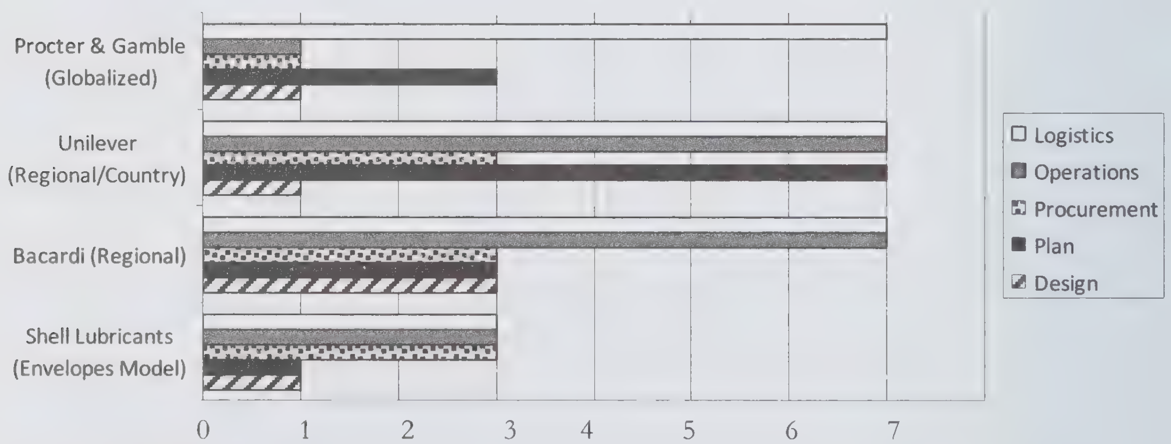
These different corporate headquarter configurations are related to the fundamental nature of the corporation's products or services, as well as corporate strategy. The extent of devolution to subsidiaries depends on the corporate evaluation of the relative benefits of headquarter control and economies of scale versus the desirability of maintaining a managerial presence near production or markets.

Thus, large global corporations that produce homogenous goods and incur huge capital costs, such as integrated oil and gas companies, place a premium on the capital-raising functions of the corporate headquarters. It makes sense for them to limit subordinate discretion because it is possible to use standardized approaches to extraction and processing regardless of where the company operates. The Dutch multinational Shell reflects this tight headquarters structure.

However, in situations where local preferences and regulatory conditions call for differentiated products, such as in food processing, it makes sense to devolve responsibilities to subsidiaries that are better able to vary a core product or function to local tastes and regulatory requirements. Transportation costs and local manufacturing costs and capabilities can also have an impact on the number of headquarters operated by a company. Those factors tend to favour devolved headquarter structures for consumer product companies like Bacardi and Unilever.

Another reason for devolution to subsidiaries is when these can serve as corporate "centres of excellence". In this approach, a division may take the lead in a certain area where it is seen to have special expertise. For instance, when Falconbridge was taken over by Xstrata in 2006, the Canadian headquarters was handed the global product mandate for nickel (the Canadian subsidiary is now called Xstrata Nickel) because of Falconbridge's capabilities in nickel extraction and processing. Similarly, Belgium-based Interbrew's acquisition of John Labatt Ltd. resulted in the Toronto office taking charge of technology for the Americas.[8]

Chart 1: Headquarters Involved in Decision Making by Supply Chain Model (Number of headquarters)*



*selected companies
Source: Adapted from: George Yip, "Global Supply Chains Paradigm".

Scale economies can also be achieved through the relationship between subordinate units. In some configurations, subsidiaries are tightly interlinked with one another in

[8] Bloom and Grant, *Hollowing Out, Vol. II.*

provider-customer type relationships. Companies will often engineer their own global value chains by taking stakes in subsidiaries and then linking these subsidiaries together in a network. That explains why intra-firm trade is an important part of global supply chains.

Headquarters are not created equal in their decision making power and staffing. Similarly, their impact on value chains and the national economy also varies considerably. Headquarters are differentiated in terms of corporate mandate and function; distinctions that can have very important implications for the size and benefits associated with hosting headquarters.

Although the size of headquarters generally grows with corporate revenues, revenue is not always the most important determinant or factor in a headquarter's impact, especially in cases of devolved headquarters structures. For instance, the leveraged buyout company, Kohlberg Kravis Roberts & Co., employs fewer than 80 people at headquarters yet reports over $40 billion in revenue. Meanwhile, before a restructuring in the 1990s, Coca-Cola Enterprises Inc. had nearly 5,000 employees at its corporate headquarters with less than $20 billion in revenue. [9]

Wide variations are found within some industries. For example, Hoescht, the German chemical and pharmaceutical company had 180 people in its corporate headquarters at the same time as its competitor Bayer had several thousand. This suggests that headquarter configurations are as much a matter of corporate strategy as they are the result of the underlying business of firms. Indeed, this explains why the configuration of headquarters often changes significantly with the arrival of a new Chief Executive Officer or after a merger or acquisition.[10] (These differences will be considered again, below, when Canadian headquarters are compared with those of other countries).

Headquarters and Global Value Chains

Headquarters are instrumental in the formation of global value chains. Global value chains are one manifestation of a corporation's search for efficiency as it competes for profits and market share. The corporate headquarters determines a strategy and then deploys it through its subordinate headquarters structure. Depending on the nature of that structure, this may result in a different pattern of trade. If that strategy involves the development of global supply chains, then it will be reflected not so much in the domestic headquarters but rather in the subordinate structure.

As an indication of how global supply chains are affecting headquarters structures, Sydor notes the growth of multinational corporations and their affiliates. In 1990, there were 37,000 multinational enterprises and around 170,000 foreign subordinates. By 2004, the number of multinational enterprises had roughly doubled while the number of foreign subordinates had grown by over four fold. Much of this growth, especially in foreign subordinates, can be found in developing countries. Developing countries now account for about a quarter of all multinational corporations and they host about half of the foreign subordinates.[11]

These statistics speak to the fact that global value chains are very much a phenomenon of the integration of the developing world into multinational supply

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[9] These examples are provided in: Collis, Young and Goold, "The Size, Structure and Performance", p.13.

[10] We document this in Bloom and Grant, *"Hollowing Out": Myth and Reality.*

[11] Sydor, "The Rise of Global Value Chains", p. 50.

networks. Recently foreign direct investment flows to developing countries have come in two waves. The first, in the mid 1990s, was marked by China's initial opening up to global investors and Mexico's integration into the North American economic space. The second, in the 2000s, saw China expand further and the emergence of the other members of the BRIC countries, namely Brazil, Russia and India.

The integration of the developing world into global supply chains directly impacts the number of headquarters in several ways. First, it increases the number of sub-manufacturing headquarters, as now there is often a need for regional or country headquarters to co-ordinate production. Second, as countries grow, they become important markets for consumer products which, as indicated above, tend to require devolved headquarter structures. Finally, as countries become more technologically sophisticated they may become established as national centres of excellence, thereby attracting headquarters to take advantage of leading-edge capabilities for innovation and high-quality production.

The structure of affiliate headquarters has an impact on trade flows because more trade flows are now "in-house" between affiliates of the same corporation. For instance, Beugelsdijk et. al. analyzed trade flows of U.S. affiliates in 56 host countries between 1983 and 2003. Among US affiliates in developing countries the proportion of host-host, intra-firm trade increased significantly during this time. This was matched with a decline in the proportion of host-home and inter-firm trade. So multinationals have engineered greater vertical specialization by exploiting factor cost differentials across countries.[12]

Why Care About Headquarters?

When Canada experienced a wave of foreign mergers and acquisitions from 2005-07, there was much concern domestically about the loss of Canadian headquarters. This was often expressed as worries about the "hollowing out" of corporate Canada, as the takeover target's head office presence was perceived to be diminished through acquisition foreign-owned enterprises. At that time, there was a national debate about the value of headquarters.[13]

There are several reasons to care about headquarters. First, they employ highly skilled people as senior management, accountants, financiers, and information technology and human resource specialists. The corporate headquarters for a large company may comprise four of five C-level executives, 10-25 senior executives and scores of senior managers as well as highly paid specialists. These people invariably are well-educated and have considerable work experience, which is reflected in their salaries. In 2005, average salaries at head offices in Canada were $74,900, about double the average Canadian salary.[14]

In addition, headquarter's staff typically require ancillary services from other highly skilled management consultants, lawyers, financial services companies, auditors and technology companies. For these reasons headquarters are seen as engines for generating high paying jobs which in turn spillover beneficially to the local economy.

As will be explored later, there is a tendency for headquarters to cluster in urban centers. When this clustering occurs, it can affect the surrounding economy. Clustering

[12] Beugelsdijk, Pedersen, and Petersen. "Is There a Trend Toward Global Value Chain Specialization?"

[13] See, for example: Martin and Nixon, "A Prescription for Canada: Rethink Our Tax Policy."

[14] Competition Policy Review Panel. *Compete to Win.* p.71.

often leads to technological spillover effects as headquarter centers provide economies of scale in industries that service headquarter functions.[15] That same infrastructure then creates the foundation for medium-sized companies to grow and prosper.

Further, headquarters are decision-making centres. They are both part of global value chains and they *create* global value chains. They determine organizational structure which, in turn, influences headquarters structure. This, in turn, affects a country's role in global innovation and productivity processes. Corporate headquarters, in particular, play a critical role in aggregating and distributing corporate resources. Engagement in global value chains is generally thought to reflect an engagement in international markets and the search for efficiency. The OECD has found that countries that are engaged with global forces tend to have higher productivity.[16] If headquarters are the mechanism for that engagement, then a strong argument can be made that headquarters are productivity-raising and therefore contribute to national prosperity and well-being.

The desirability of hosting a headquarters is part and parcel of the productivity enhancing processes of the underlying enterprise and the role of the headquarters in those processes. This is what drives the high wage jobs that we observe in headquarters, yet these process also exist outside of the headquarter function.

There is also the question: is there a home country 'bias' with headquarters? There is evidence that innovation and managerial decision centres profit disproportionately from global value chains.[17] Other research has shown a tendency for multinationals to repatriate their profits from subsidiaries.[18] Large research-intensive multinationals tend to conduct R&D in their head office city region. On the other hand, most have located, or are in the process of locating, their latest R&D facility elsewhere. Leading R&D performers increasingly choose locations that align with their research interests or their customers.[19] Headquarters also tend to favour local charities when making philanthropic decisions.

The Institute for Competitive and Productivity at the University of Toronto's Rotman School of Business found that these benefits of headquarters held for both Canadian and foreign-owned headquarters.

The existence of a headquarters, in itself, is not necessarily indicative of a high productivity enterprise or high productivity processes at headquarters. There has been a tendency to downsize corporate headquarters in instances where they become bureaucratic and detract from corporate value. Also, there is a significant difference between different types of headquarters in terms of their contribution to corporate value, depending on the nature of the enterprise and headquarter structure. A regional sales headquarters for a global enterprise has a very different function than a subordinate headquarters with a global manufacturing mandate.

The evidence suggests that the impact of headquarters varies significantly depending on:

a) Size of the headquarters
b) Productivity of the underlying enterprise and its global engagement;
c) Headquarters' role in the enterprises' productivity;

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[15] Klier and Testa, "Location Trends".

[16] OECD, Moving Up the (Global) Value Chain.

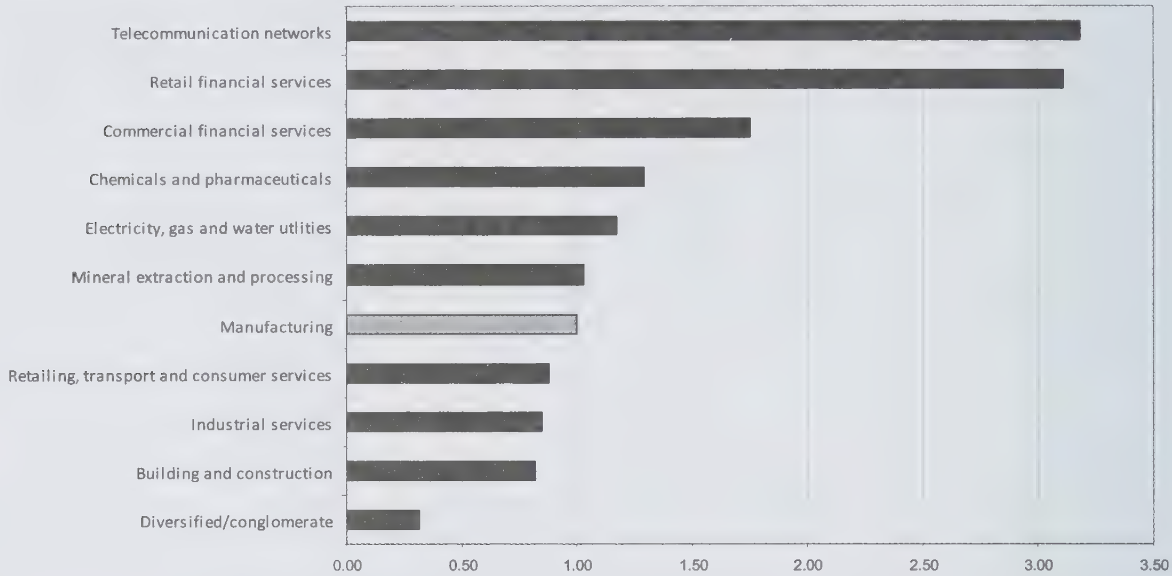
[17] Dedrick,Kraemer, and Linden, "Who Profits from Innovation in Global Value Chains?.

[18] Matthias Dischinger and Nadine Riedel, "There's No Place Like Home:"

[19] Institute for Compettiveness and Prosperty. "Flourishing", p.15.

d) Whether there is a host country bias in headquarters decision making;
e) Whether headquarters cluster together.

Chart 2: Relative Headquarters Size by Sector, Manufacturing=1 (N=467)



Note: Sample drawn from France, Germany, the Netherlands, the UK, the USA, Japan and Chile. The index is controlled for company size.
Source: Collis et. al. "The Size, Structure and Performance", Table 8.

What Determines Headquarters Size?

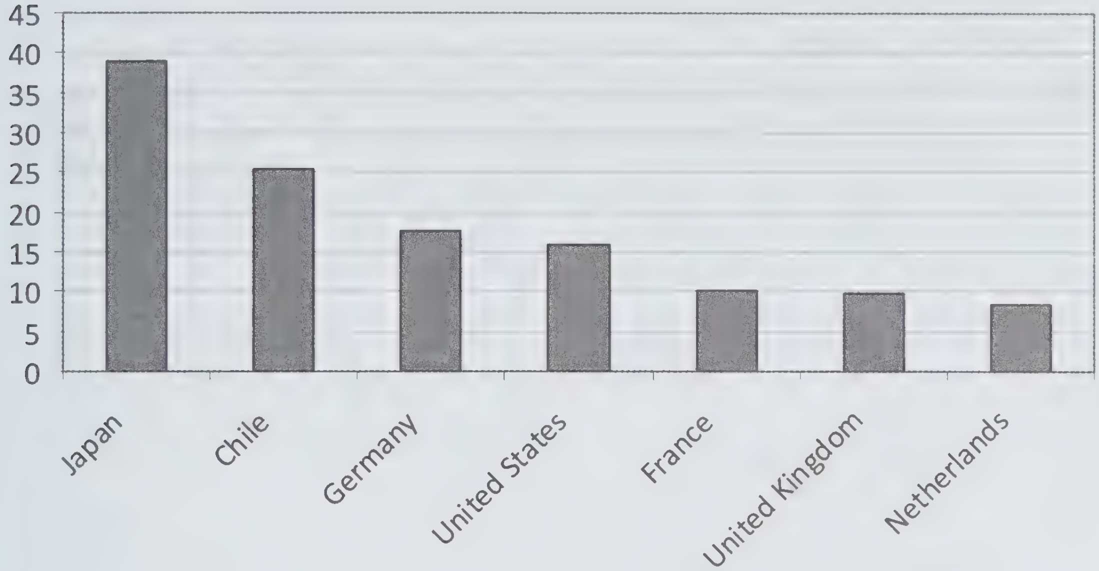
Headquarters are designed to concentrate managerial functions in areas where there are returns to that concentration. As headquarters' economies of scale diminish, headquarters add fewer people per unit of output. So while the size of headquarters is positively related to the number of employees in the corporation, larger corporations have proportionately fewer headquarters employees.

In an international survey of headquarters, Collis et. al. found that a doubling of company size corresponds to about a 25 percent drop in the proportion of employees working in headquarters. They also found significant differences in headquarters staffing across industry sectors.[20] This reflects the aforementioned differences between industries regarding the need for concentrated versus diffuse headquarters structures.

These data confirms two countervailing forces. On the one hand, companies with operations in one country, such as telecommunication companies and utilities tend to have large headquarters. Yet large headquarters are also a feature of companies with wide geographic scope of operations. Even though these globalized companies may devolve decision making outward to subsidiaries, their greater geographic spread requires a larger corporate headquarters to co-ordinate the full range of their global activities. Given these forces, a large headquarters may indicate either less engagement in global value chains or more engagement, depending on the nature of the business.

[20] Collis, Young and Goold, "The Size, Structure and Performance", p.30.

Chart 3: Mean Headquarter Staff per Thousand Employees, Selected Countries



Source: Collis et. al. "International Differences", Table 2.

There are significant cross-country differences in headquarter staffing. Apart from Germany, which tends to have headquarters of similar size to the United States, most European countries sampled had significantly smaller headquarter than in the United States. Japan tends to have very large headquarters, as does Chile.

To put this in concrete terms, a European corporation with 20 thousand employees will typically employ 124 people at headquarters compared to 255 for a similar-sized US corporation and 467 for a similar Japanese firm. The US was also found to have significantly larger legal, tax, and treasury functions than the common European model, perhaps reflecting its litigious corporate culture. The authors cite cultural and home country differences to account for country variations in headquarter size.[21]

What Attracts Headquarters?

Headquarters are attracted by factors that maximize their productivity. They look to locate in centres that facilitate the efficient gathering and use of information and that offer easy access to sources of finance and skilled people. Subordinate headquarters locations are more likely to be influenced by proximity to customers and/or efficient production facilities. Subordinate headquarters, too, want to efficiently gather and use information and so they will tend to be located near major regional centers.

Taxes, whether in the form of tariffs or corporate income tax, can also have a powerful influence on headquarters location. California, for instance, hosts fewer major headquarters than Texas largely because of its more punitive tax system (e.g. the unitary tax). As tariff barriers have fallen, the relative importance of other corporate taxes has increased. Major changes to corporate taxation can have a significant effect on headquarters' decisions.

Access to information processing and finance leads to most headquarters gravitating towards cities. There are two agglomeration forces that help explain the geographic

[21] Collis et. al. "International Differences".

concentration of headquarters. First, large metropolitan areas offer a wide diversity of large-scale business and financial services that make headquarters operations more efficient. Second, these centers allow the clustered headquarters to exchange information and develop a sense of market conditions. Cities are also well served by networking infrastructure in the form of advanced telecommunication networks and airports. [22]

Lovely et al. empirically tested the proposition that a need to obtain information contributes to headquarters agglomeration. They found that the spatial concentration of headquarters is higher among exporters to difficult markets than for other exporters or domestically oriented firms. That is, agglomeration increases as the need to obtain information about relatively unknown markets increases.[23]

The agglomeration of headquarters may lead to higher headquarters costs as headquarters tend to bid up prices. For this reason, corporations will often limit their corporate headquarters to major centres and disperse subordinate headquarters functions to medium-sized regional centres that are still large enough to support good networking infrastructure and attract talented people. Any factors that increase the cost of headquarters in relationship to the corporate value of the headquarters will have a tendency to thwart the creation of headquarters. This includes unpredictable or burdensome public policy regimes or sudden increases in corporate taxes. In some cases this may lead to headquarters reconfiguring the responsibilities between the corporate headquarters and subordinate headquarters to reduce overall headquarter costs. In extreme circumstances, it may involve headquarters moving locations.

Why Do Headquarters Move?

Headquarters move because either their business changes or the business environment around the headquarters changes. The most common case of the former is when a merger or acquisition results in a rationalization of the headquarters function. That usually involves rationalization towards one center, resulting in either the diminishment or elimination of (usually) the targets' headquarters (i.e. the firm that has been acquired).

One of the most comprehensive studies of headquarters movement was conducted by Strauss-Kahn and Vives for the United States. Using a database of 30,000 headquarters in the continental US, they found that, between 1996 and 2001, 1,500 of these moved, a rate of 5 per cent over the period, or 1 per cent annually. The authors found that headquarters tend to relocate to metropolitan areas with good airport facilities, low corporate taxes, low average wages, high levels of business services, same industry specialization, and agglomeration of headquarters in the same sector of activity. That is, the factors that attract headquarters are also the factors that cause them to move to other centres.

Strauss-Khan and Vives also found that headquarters that are larger (in terms of sales) and younger (in terms of time in a given location) tend to relocate more often, as do firms that are larger (in terms of the number of headquarters), are foreign, or are the outcome of a merger. Headquarters that are already in locations with good airport facilities, low corporate taxes, and with significant agglomeration of headquarters in the same sector of activity tend to stay put. So, if a centre has attracted a sufficient number of headquarters, it is likely to keep them unless, of course, any of the key environmental factors changes.

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[22] Bel and Fageda, "Getting There Fast", p.471.

[23] Lovely et. al, "Information, Agglomeration".

Recent Trends in Headquarters

As with business in general, the headquarters function is constantly evolving as corporations strive to improve performance.

One trend is that the global distribution of headquarters is shifting towards developing countries. This is a natural outcome of the integration of developing countries into global value chains. As noted above, the number of foreign affiliates of multinationals in developing countries has grown rapidly in recent years. With this growth comes the establishment of regional headquarters of multinationals to oversee production from new centres and distribution to rising markets.

Table 2: Net Changes in Headquarters: Four Country Comparison (% reporting increase less % reporting decrease)

PAST FIVE YEARS	Germany	UK	U.S.	Japan
Number of staff	-14	-19	19	-39
Outsourcing	47	32	37	-3
HQ influence	2	15	27	n.a.
Services provided	25	13	36	7
FUTURE FIVE YEARS				
Number of staff	-33	-22	-13	-70
Outsourcing	35	36	40	10
HQ influence	2	19	20	n.a.
Services provided	14	3	30	8

Source: Collis et. al. "International Differences", Table 7.

Within the developed world, a second trend has emerged: increasing convergence towards a common headquarter model based on that of the United States. Collis et. al. found that the countries with the largest headquarters, such as Japan and Germany, were most dissatisfied with their performance and therefore more inclined to call for reductions in staff and influence. Although US corporations had relatively large headquarters, they tended to be more satisfied with their performance and therefore a relatively small number of these corporations suggested that there would be declines in headquarters staff and a larger share of respondents thought headquarters influence would grow over time.

A final trend, noted through US research, is the movement of headquarters away from high cost centres toward regional centers that possess many of the characteristics (low taxes, good networking infrastructure) that headquarters find desirable while offering lower costs. Although major centers like New York and Houston continue to be favoured by Fortune 500 companies, these centres are increasingly challenged by medium-sized cities such as Greensboro and Pittsburgh that offer attractive features such as tax breaks and modern infrastructure.

Table 3: United States Metropolitan Centres Net Gain and Loss of Headquarters 1996-2001

Metropolitan Area	Net Change in number of headquarters
Gaining	
Greensboro-Winston-Salem-High Point	10
Pittsburgh	10
San Diego	7
Detroit-Ann Arbor-Flint	7
Phoenix-Mesa	6
Indianapolis	5
San Antonio	5
Dallas-Fort Worth	5
Raleigh-Durham-Chapel Hill	4
Nashville	4
Jacksonville	4
Losing	
New York-New Jersey-Long Island	-32
Cleveland-Akron	-10
San Francisco-Oakland-San Jose	-8
Youngstown-Warren	-8
Minneapolis-St. Paul	-8
Philadelphia-Wilmington-Atlantic City	-7
Los Angeles-Riverside-Orange County	-7
Denver-Boulder-Greeley	-3
Tulsa	-3
Rochester	-3
Atlanta	-3
Allentown-Bethlehem-Easton	-3

Source: Strauss-Kahn and Vives "Why and Where Do Headquarters Move?" p. 181.

Table 4: Top Ten US Cities Ranked by Fortune 500 Headquarters, 2009 (number of HQs)

New York	43
Houston	27
Dallas	14
Atlanta	9
Chicago	9
Minneapolis	9
San Francisco	7
St. Louis	7
Charlotte	6
Los Angeles	6

Source: Fortune

This evidence suggests that headquarters are becoming more dispersed and, in some cases, smaller, in response to shareholder demands for greater value.

Where Does Canada Fit In?

During the 2005-07 mergers and acquisition wave, and in response to the Competition Policy Review Panel's investigation into Canadian competitiveness, Statistics Canada produced several studies looking at headquarters.[24] Some of this work was based on the Statistics Canada Business Register, a database that which allows researchers to look headquarters as separate managerial units. The original work dated to 2007; we had Statistics Canada update the data to 2009 for this report.

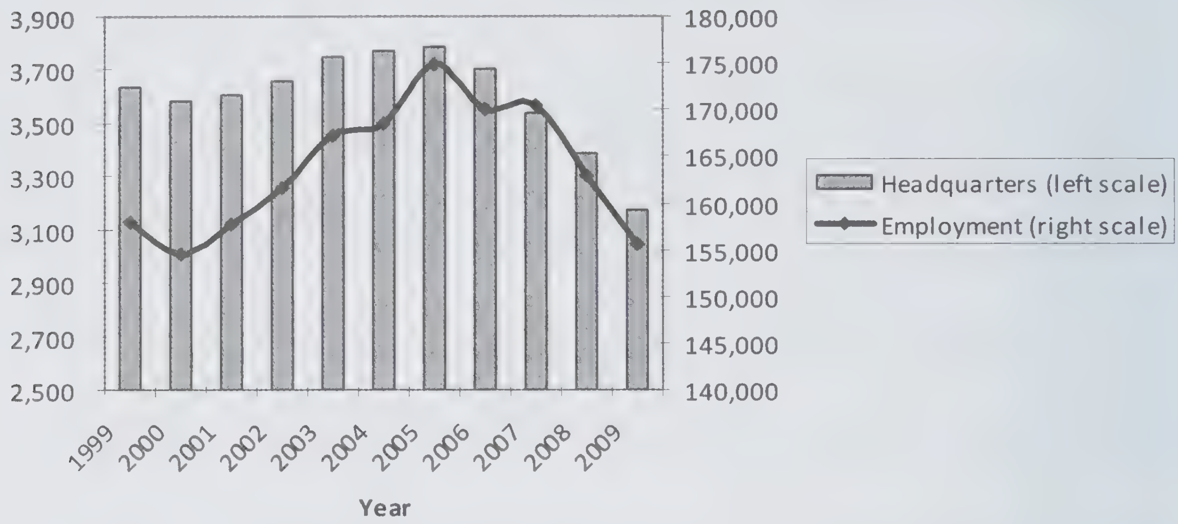
Recent Trends

The first fact that stands out from the updated data is that the number of Canadian headquarters has fallen since 2005 and now stands at the lowest level in over 10 years. The number of headquarters has fallen by 17 per cent since 2005. One reason for this is the wave of foreign acquisitions in the 2005-2007 period which led to some consolidation of headquarters. A second reason is the worldwide recession since 2007, which has seen a reduction of headquarters globally. As shown elsewhere, the changing fortunes of companies are a much more powerful influence on the number and nature of headquarters than are mergers and acquisitions.[25]

[24] Beckstead, and Brown, Head Office Employment in Canada 1999-2005. Baldwin, Beckstead and Gellatly. Global Links: Multinationals in Canada.

[25] Bloom and Grant, *Hollowing Out,* Vol. 1.

Chart 4: Number of Headquarters and Headquarter Employment, Canada, 1999-2009



Source: Custom Run of Statistics Canada Business Register Database

Table 5: Average Canadian Headquarters Size, by Sector, 2009

Agriculture, Forestry, Fishing and Hunting	7
Mining and Oil and Gas Extraction	50
Utilities	351
Construction	17
Manufacturing	68
Wholesale Trade	39
Retail Trade	28
Transportation and Warehousing	84
Information and Cultural Industries	58
Finance and Insurance	106
Real Estate and Rental and Leasing	22
Professional, Scientific and Technical Services	34
Management of Companies and Enterprises	187
Administrative and Support, Waste Management and Remediation Services	28
Arts, Entertainment and Recreation	20
Accommodation and Food Services	14
Other Services (except Public Administration)	15

Source: Custom Run of Statistics Canada Business Register Database

Half the decline in headquarters is accounted for in two sectors: retail trade, which accounted for 28 per cent of the decline, and manufacturing, which accounted for a further 22 per cent. But since manufacturing headquarters are typically three times as large as retailer headquarters, manufacturing accounted for almost 60 per cent of the decline in headquarters employment. That supports the view that the decline in headquarters and

headquarters employment is closely related to recessionary forces that have hit these two sectors hard.

The pattern of Canadian headquarters by sector largely conforms to international experience: utilities and financial services have especially large headquarters. The main exception is in the "management of companies" sector, in other words, conglomerates. According to the Statistics Canada data, this sector historically has had a small number of relatively small headquarters. However, in 2008-09 there was a significant increase in both the number of headquarters, employment in headquarters and the size of headquarters in this sector.

On average, Canadian headquarters employ 49 people, a number that has actually increased slightly since 1999. The Business Register data is not strictly comparable to Collis' international data which is based on the ratio of headquarters employees to total employees. However, research carried out for the Canadian manufacturing sector found that headquarters employment was about 12 people for every thousand employees, which would put Canadian head office employment in line with that of the United States. This is not surprising given the similarities between the Canadian and United States business cultures and approaches to management.[26]

Canadian companies typically account for about 3 times as many headquarters as foreign companies. This is because there are more Canadian-owned companies in Canada than foreign-owned companies and because Canadian companies will often have multiple Canadian headquarters. Yet foreign headquarters tend to have somewhat larger headquarters than Canadian companies, at about 60 employees per headquarters. Even though foreign firms, on average, employ more people, they have an ambiguous impact on head office employment. On the one hand, the arrival of a foreign firm through acquisition may result in a downsized Canadian headquarters. This is what happened following the 2005-06 wave of foreign acquisitions of Canadian companies. But on the other hand, foreign firms accounted for most of the growth in head office employment in the 1999-2005 period because they were expanding their presence in the Canadian market through new headquarters.[27]

Turnover

These top line changes disguise considerable flux in the number of headquarters. For instance, Beckstead and Brown found that 37 per cent of the headquarters that existed in 1999 had exited by 2005.[28] Yet these were replaced by the 38 per cent of the headquarters that did not exist in 1999. That suggests that over a 6 year period about 40 per cent of headquarters may turnover. As we discuss below, there is a much higher rate of headquarters turnover that results from changing business conditions than that which is due to headquarters moving location, which is typically about 1 per cent annually.

City Agglomeration

Research shows that headquarters tend to agglomerate in cities. It is worthwhile to consider how Canadian cities have fared in attracting and retaining headquarters. We

[26] Calculated based on data in Baldwin and Brown. *Foreign Multinationals and Head Office Employment.* p.12.

[27] Beckstead and Brown, W. Mark, *Head Office Employment in Canada 1999-2005.*

[28] Ibid, p.12.

looked at seven major urban centers: Montréal, Ottawa-Gatineau, Toronto, Winnipeg, Edmonton, Calgary and Vancouver.

Table 6: Headquarters and Headquarters Employment, Selected Cities, 1999 and 2009

	Headquarters		Employment	
	1999	**2009**	**1999**	**2009**
Toronto	826	793	49,649	54,435
Montréal	596	443	36,763	32,840
Vancouver	355	279	16,894	10,094
Calgary	279	253	11,815	15,697
Edmonton	139	132	2,972	3,790
Winnipeg	114	105	7,410	5,881
Ottawa-Gatineau	100	83	3,634	4,369
Total for Seven Centres	**2,409**	**2,088**	**129,137**	**127,106**
Seven Centre Share of Canada	**66%**	**57%**	**81%**	**82%**

Source: Statistics Canada Business Register Custom Run. The Conference Board of Canada.

In aggregate, the seven major centres lost headquarters over the period, both absolutely and in relationship to other Canadian centres, as indicated by their falling number of headquarters and falling share of total headquarters in Canada. Yet they maintained their share of headquarters employment. This suggests that major Canadian cities retain larger headquarters and tend to lose smaller headquarters. The average size of headquarters in these major cities actually increased from around 53 to 60 in the 1999-2009 period. Given that 2009 was at the tail end of a recession, this suggests that smaller headquarters may be more sensitive to the high overhead costs of operating in major centres over the course of the business cycle.

Over the past decade, both Montréal and Vancouver have seen significant declines in both the number of headquarters and headquarters employment. In Montréal's case, the issue may be related to corporate concerns about its relatively unsettled political situation. In Vancouver, the challenge is the relatively high cost of living. The literature shows that both factors tend to affect the number of headquarters and the employment levels in headquarters.

International Comparisons

It is difficult to compare headquarters among countries because countries have different ways of defining headquarters. At any rate, it is not clear that the number of headquarters matters as much as the nature of headquarters. As we have already argued, the benefits associated with headquarters are very much related to their size, their global engagement and whether a country tends to host clusters of these headquarters. These types of large, globally-engaged, clustered headquarters tend to be a small fraction of the total.

To illustrate, the Institute for Competitiveness and Prosperity has attempted to gauge "global leader" Canadian-owned and headquartered companies.

Table 7: Canadian-Headquartered Global Leaders, April 2008

Abitibi Bowater	Cott	Major Drilling	Shawcorp
Agrium	Couche-Tard	Manulife Financial	Sierra Wireless
Ahton-Potter (MDC)	Dalsa	McCain	SMART Technologies
Atco	Exfo Electro-Optical Engineering	MDS	SNC-Lavalin
ATS	Finning International	Methanex	Spectra Premium Industries
Barrick Gold	Fording (Elk Valley Coal)	Mitel	SunGro Horticulture
Bombardier	Garda World	Norbord	TD Waterhouse
CAE	Gildan	North American Fur Auctions	Teck-Cominco
Cameco	Goldcorp	Nortel	Tembec
Canam Steel	Harlequin (Torstar)	Nova Chemicals	Thompson Creek Metals (Blue Pearl)
Canfor	Husky Injection Molding	Open Text	Thomson Corporation
CCL Industries	Imax	Patheon	Timminco
Celestica	Jim Pattison Group	Peerless Clothing	TLC Vision
CGI	Maax Holdings	Pollard Holdings LP	Transat A.T.
CHC Helicopter	MacDonald Dettwiler	Potash Corp.	Trimac
Chemtrade Logistics	Magna	Premier Tech	Velan
Cinram	Magnequench (Neo Material Technologies)	Quebecor World	Westcast Industries
Cirque du Soleil		Research In Motion	Weston Foods
CN Rail		Ritchie Bros. Auctioneers	Zarlink
Connors Bros.		Scotia Mocatta	

Source : Institute for Competitiveness & Prosperity. *Flourishing in the Global Competitiveness Game.*

The Institute defines a Canadian global leader by size (revenues exceeding $100 million) and market share (top five in its market segment globally). In April 2008, Canada had 77 global leaders. This was double the 1985 figure, yet down from the peak of 83 in 2003. Either way, the number of "global leaders" is only a small fraction of the 2,000 Canadian-owned and Canadian-headquartered companies. And few of these global leaders were on the list in 1985, suggesting that the emergence of new companies such as Cirque du Soleil, Research in Motion, Open Text and Finning International is a very important factor in the number and size of major headquarters.

Another relevant measure is Canada's share of large global headquarters, as captured by the Fortune Global 500 list of the world's largest companies. In 2009, 14 Canadian companies made this list. However, most are relatively small in global terms and/or focused primarily on the Canadian market. Only 4 of the 14 companies are both large and "global leaders" as defined by the Institute for Competitiveness & Prosperity. So although Canadian companies appear to be represented in line with Canada's share of global output (2.5 per cent), this share seems to reflect the size of Canada's local market and its natural resource endowment more than the global ambitions and activities of its companies.

Table 8: Canadian-Headquartered Global 500 Companies, 2009

Country Rank	Company	Global 500 Rank	Revenues ($ million s)	City	Global Leader?
1	Royal Bank of Canada	211	36,616	Toronto	
2	Power Corp. of Canada	226	35,125	Montreal	
3	George Weston	254	32,361	Toronto	x
4	Manulife Financial	276	30,948	Toronto	x
5	EnCana	284	30,064	Calgary	
6	Suncor Energy	325	27,680	Calgary	
7	Petro-Canada	340	26,054	Calgary	
8	Bank of Nova Scotia	343	25,944	Toronto	
9	Onex	353	25,207	Toronto	
10	Toronto-Dominion Bank	354	25,070	Toronto	
11	Magna International	384	23,704	Aurora	x
12	Husky Energy	396	23,162	Calgary	
13	Bombardier	468	19,721	Montreal	x

Source: Fortune. Conference Board of Canada

By way of comparison, the Netherlands is a good example of a relatively small economy that is home to large globally-orientated headquarters. It has a gross domestic product about half the size of Canada. Yet it hosts (with Britain) Royal Dutch Shell, the world's largest company by revenue in 2009. Moreover, it is home to the financial service leader ING Group, the aerospace company EADS and electronics giant Royal Phillips.

These Dutch companies are larger and more globally orientated than *any* Canadian-headquartered company. Even though the Netherlands has two fewer companies on the Fortune Global 500 list, the combined global revenues of those companies are over $US 650 billion greater than the fourteen Canadian companies on the list.[29]

This is significant because corporate size is important: global value chains are disproportionately constructed by the largest multinational companies. The 100 largest non-financial multinationals accounted for between 10 to 15 per cent of the foreign assets, sales and employment of all the multinationals in the world.[30] They have been steadily increasing the foreign assets over the last 20 years. Thus, while the Netherlands may have fewer headquarters than Canada, the size of its largest companies means that their headquarters are more likely to make significant decisions about global value chains. And the spillover benefits from these companies is also likely greater.

[29] Calculated from Fortune, *Global 500, 2009.*

[30] United Nations Conference on Trade and Development (UNCTAD) *World Investment Report,* p. 18.

Interview Findings

About the Interviews

In order to probe deeper into the relationship between headquarters and global value chains, 10 corporate executives from large companies were interviewed. The companies were selected with an eye towards diversity; we wanted to include both large global companies with operations in Canada as well as domestic companies whose supply chains are increasingly global. The purpose of the interviews was to deepen our qualitative understanding of the way corporations make decisions about their headquarters and involvement in global value chains. Given the small sample size, we did not seek to generalize from what we learned of the experiences of these companies. Rather, the purpose of the interviews was to get a sense of the managerial decisions behind the number and location of headquarters and their relationship to global value chains.

Box 2, below, describes the sample of 10 companies. All the interviewees represented companies with significant sales; the smallest had annual revenues of just over $3 billion. Companies of this size tend to have more complicated supply chains than do smaller companies. The interviews were with senior executives with responsibility for supply chains. As senior executives, these interviewees had strong insights into the drivers of headquarter location. As they had direct responsibility for supply chains, they were also in a good position to comment on the evolution of their companies' value chains and particularly the relationship between headquarters configuration and value chains.

Box 2: About the Interviewees (n=10)

Size of Companies	*Low*	*High*	*Mean*	*Standard Deviation*
Sales ($Millions)	$ 3,100	$ 110,500	$ 29,428	40,413
Market Cap ($millions)	$ 4,300	$ 167,650	$ 35,957	51,303
Employees (thousand)	3	405	115	155
Sectors				
Airline				
Computer hardware and services				
Engineering (2)				
Equipment (2)				
Medical supplies				
Mining				
Retail				
Telecom				

Orientation				
Domestic	2			
Multi-domestic	2			
Transnational	4			
Global	2			
	Low	*High*	*Mean*	*Standard Deviation*
Number of countries that company….				
Operates in	1	175	57	59
Sources inputs	3	85	28	28
Sells	1	110	48	48

Main headquarters is …	
Canadian	4
Foreign	6

A condition for their participation was that the companies not be named, for reasons of commercial confidentiality. Since the analysis focuses on overarching themes rather than details of specific cases, the companies are refered to using general descriptors.

Key Themes Emerging from the Interviews

The advantage of an interview methodology is that it reveals nuances that may get lost in pure statistical analyses. The fact is that corporate strategies and transformations can be very difficult to categorize and attempts to do inevitably end up simplifying. Yet complex corporate strategies are the main determinant of the number of headquarters and the configuration of global value chains.

Two overarching themes emerge from the interviews. First, there are clear pressures for companies to transform their global value chains to remain competitive. Second, the number of headquarters is less important than what headquarters do. The mere existence of a large company headquarters is not necessarily an indication of engagement in a global value chain. Moreover, a focus on the movement of headquarters locations is less important than the transformation of the role of headquarters. In fact, those roles are changing much faster than are headquarters locations.

There is a clear trend towards all the interviewed companies becoming increasingly globalized, largely as a consequence of the economic emergence of the developing world. Developing countries are very attractive sources of inputs and, over time, are becoming more attractive as end markets. The integration of developing countries, especially in Asia, into global value chains has affected all the companies in our sample. But the question is how this integration plays out in corporate transformations and specifically the relationships between corporate and affiliate headquarters.

Engagement in Global Value Chains

The interviewed companies differed significantly in the extent to which they are engaged in global value chains. At one extreme were large Canadian-controlled domestic

companies that have very little engagement in global value chains. At the other end of the continuumare large foreign-owned companies that are very engaged in global value chains and whose Canadian operations are part and parcel of that engagement.

Highly regulated Canadian companies with a domestic market orientation, such as telecoms, utilities and retail financial services are, not surprisingly, mostly disengaged from global value chains. On the other hand, domestic retailers have been pushed to source their inputs globally for cost competitive reasons. For some, this has involved the extension of their supply chains to East Asia and, to a lesser extent, India. Initially they did so through standard buying arrangements. But as the breadth and sophistication of imported products evolves, these retailers became increasingly involved in establishing separate regional supply headquarters in those countries from which they source goods.

For example, a large Canadian retailer told us that it had been through this process over the last 10 years. The company established a regional manufacturing headquarters in Shanghai and a logistics headquarters in Hong Kong. The Shanghai headquarters' role was to manage relationships with regional vendors to control quality and production schedules. The Hong Kong headquarters' role was to ensure that goods arrived in a timely fashion in the Canadian marketplace.

About a quarter of Canadian headquarters (and a third of headquarters employment) is associated with foreign affiliates. There was an uptick in the number of affiliates following the wave of foreign acquisitions of Canadian companies, 2005-07. Many affiliates were set up essentially as sales and marketing operations with a limited geographic mandate for Canada, for example, in office equipment. Some foreign-owned companies went a step further and established local manufacturing capabilities, such as in computer services, automobiles and pharmaceuticals.

Given the trend toward globalization by large companies, the question then becomes: how can a Canadian affiliate plug into that process? It is very difficult for pure sales and marketing affiliates to transform their role to become more essential to the global value chain of a global company. One executive observed the opposite: there is a tendency to degrade the responsibilities of these Canadian sales affiliates. The reason is that it is now possible to outsource a variety of corporate functions (e.g. accounting) to lower cost jurisdictions, whereas these were previously organized on a market-by-market basis in the local affiliates.

Affiliates with operational responsibilities beyond marketing and selling seem to be in a somewhat better position to transform themselves along with the global enterprise and to consequently carve out a valuable niche. For instance, we spoke with a pharmaceutical company that now integrated its Canadian research and development capacity into the parent's global research and development efforts. This means the Canadian researchers are part of much larger global research and development projects.

Similarly, an engineering company has been successful at positioning its Canadian operations to be part of international projects that service clients around the world. The company increasingly takes a portfolio approach to managing its global projects. So, for example, if the Canadian affiliate is seen as being an expert on health information system (a Canadian specialty) then that expertise will be brought to bear on all such projects undertaken overseas by the parent company. In these situations, there is a much greater fluidity in the way corporate resources are organized to satisfy client needs.

Many Ways to Add Value

There may be a tendency to think that organizational structures pre-determine the relationship and division of roles between parent and affiliate headquarters. The pursuit of global product mandates, for instance, is seen as being a "good thing" for a country. That may very well be true, but a focus on global mandates misses other ways that a corporate headquarters adds value. In the examples above, there is no "global product mandate" per se but rather shifting mandates that change constantly with client needs. When the Canadian affiliate is instrumental in satisfying those needs, due to its expertise and capacity, then it is, by definition, an important part of the global value chain.

One aspect of adding value that is often ignored is in the area of process improvement. An engineering company told us how the Canadian company was seen as an expert in critical processes (e.g. Six Sigma process improvement methods). This methodological expertise was being applied around the globe, greatly adding value to the company. Once again, that is part of "global value chain" but not necessarily directly related to the supply chain.

Home Country Bias?

Many of those who favour attracting more corporate headquarters to Canada or to a particular city in Canada tend to believe that there is a home country bias in headquarters' managerial decisions relating to procurement and the construction of global value chains. Our interviewees were evenly split as to whether they thought that there was a home country bias in procurement or whether they felt that these decisions are purely commercial. The key determinant appears to be the extent of the difference in cost between the Canadian option and a foreign supply option. If there is an existing Canadian supplier to a Canadian company, then that relationship is unlikely to be severed through modest differences in price. In other words, where economic considerations are approximately balanced, there is some home country bias, perhaps due more to the safety and convenience of existing supplier relationships located nearby than to national sentiment. But major differences in price are likely to have a very significant impact on those relationships for the simple reason that the firm in question will not be able to compete if it maintains high-cost vendor relationships.

This is why China, in particular, is having such a powerful effect on global value chains. Chinese vendors can often produce at a small fraction of the cost of Canadian-based vendors. According to one retailer we interviewed, that difference is pushing Canadian vendors into three niches where Canadian suppliers have a domestic advantage: high quality niche products, products with thin inventories that trade on immediacy of supply, and products that have a high weight/volume in relationship to their value (e.g. laundry detergent) which makes transportation costs onerous for internationally-based suppliers. A pharmaceutical manufacturer argued that there was still a lot of concern about quality control in China and that it therefore China would not push North American manufacturers out of pharmaceutical products.

How Can Canada Become More Engaged?

The interviewees made it clear that large global corporations are the primary platforms for engagement in global value chains. Canada can either develop these globally engaged companies on its own or work through existing global corporations to add value by engaging in their global value chains. It matters less whether the company in question is

Canadian-owned or foreign-owned. Rather, what matters more is whether the globalized company is a leading innovator and whether the Canadian company is a significant component of the global value chain.

The interviewee from one large mining affiliate which had recently been transformed from a Canadian-owned company to a foreign-owned affiliate, shed light on this. Although the mining affiliate had, on the face of it, a reduced mandate (relating to a particular metal) in many ways it was more engaged in global value chains than before its acquisition. For instance, the acquirer came with a managerial philosophy of devolving procurement decisions compared to the Canadian company's central sourcing. This meant that local Canadian sites had more discretion in their supply chain decisions. Moreover, the new company had a much larger global footprint than the acquired company. This meant that Canadian managers and mining engineers were much more likely to work on extremely large global mining projects: even more than before the acquisition.

In general, Canadian firms do well by becoming an integral part of large innovative companies with devolved management systems. When Canadians add value to such companies by providing higher value corporate services, which encompass everything from research and development, to process improvement, to functional expertise and project management expertise, then Canada does well. But clearly not all large companies that operate in Canada are part of these global innovation and delivery mechanisms. Many large companies in Canada are exclusively focused on the Canadian, or in some cases, North American market. The headquarters of these types of companies will produce headquarter jobs but they are much less likely to be engaged in the sort of innovation processes that are critical for Canada to carve its niche in global value chains.

What Can Governments Do?

Our interviews confirmed that headquarter location and global value chain decisions are primarily driven by historical and commercial factors. A headquarters is only as viable as the underlying enterprise. Most enterprises start small as small entrepreneurial companies with little need for a separate location headquarters. That explains why the number of headquarters is a small fraction of the number of businesses. However, as businesses grow, they develop a need for a separate management function and a headquarters is born. As such, policies that are good for growing businesses — low taxes, skilled labour, liquid capital markets, good public infrastructure— are good for headquarters.

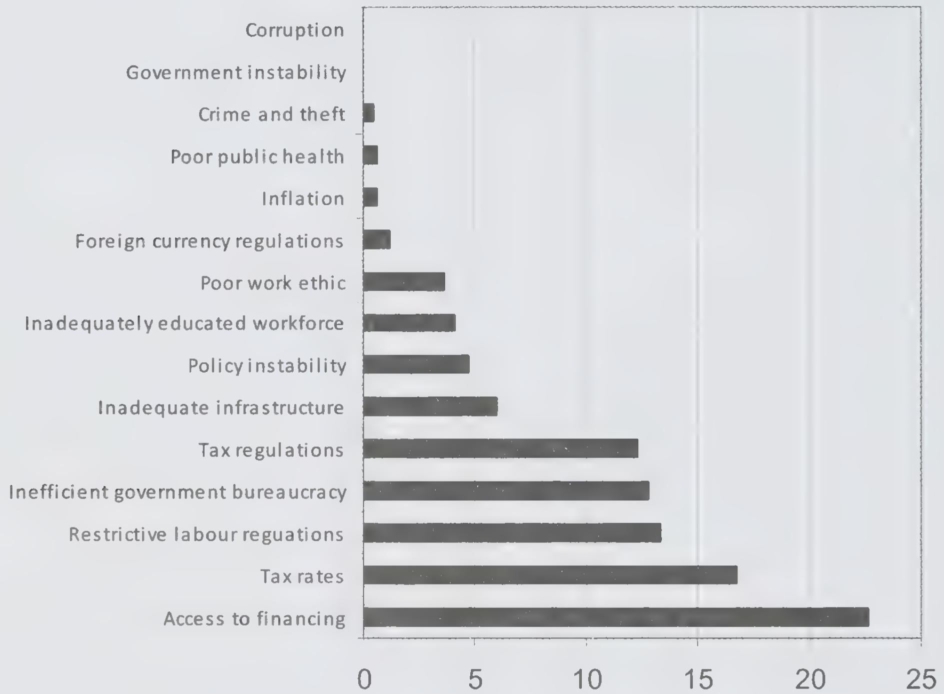
There is significant turnover in the ranks of headquarters. As we discussed, up to 40 per cent of headquarters may be gone within 6 years and replaced by new entrants. Foreign firms, in particular, are attracted to Canada when the economy is performing well. Foreign companies accounted for the lion's share of head office employment growth in the 1999-2005 period. But those entries and exits should not be construed as headquarter relocations, as research shows that only about 5 per cent of headquarters relocate over a 5 year period. Rather, foreign companies set up affiliates in Canada to either contest the domestic or North American market or take advantage of Canada's natural resources or human capital. Once establish they have, to date, moved infrequently.

So headquarters policy is largely a matter of good business policy. If Canada enhances the competitive environment for business investment, it will stimulate the creation of more headquarters by investing companies which will establish these headquarters to manage their investment. Our interviewees indicated that business people are largely averse to the government playing an activist role to attracting headquarters, through, for

instance, fiscal incentives. They are skeptical about the government's ability to pick the "right" type of headquarters to attract and are concerned that government efforts to incent headquarters to come to Canada might adversely affect the situation of existing headquarters.

As such, the interviewees favour more general policies that make Canada a desirable place to invest. That involves getting four policies right: tax, business competitiveness, infrastructure and inward investment promotion.

Chart 5: Most Problematic Factors for Doing Business in Canada, 2009, Weighted Responses (%)



Source: World Economic Forum

According to the World Economic Forum, Canada suffers from a relatively high corporate tax rate and poor tax regulatory system. Another study found, Canada had the third highest tax rate on business investment: 36.6 per cent versus the average of 20.6 per cent (for 30 countries).[31] But the United States is also a relatively high tax country, as is Germany. The difference between Canada and those countries, however, is that Canada currently is host to fewer corporate headquarters of large multinational corporations and lacks global 100 companies with very large international operations. This reality has been recognized by the federal government, which has set the goal of Canada having the lowest statutory corporate tax rate in the G7.

As the Competition Policy Review Panel has noted, Canada would benefit from reforms in its business competitiveness policy environment.[32] That includes the modernization the Canadian patent and copyright system, including improvements to Canada's counterfeit and piracy laws. The Panel also has called for the review of Canada's policy of sector specific investment restrictions. Canada maintains special foreign

[31] Martin Nixon. "A Prescription for Canada: Rethink Our Tax Policy."

[32] Competition Policy Review Panel. *Compete to Win*

restrictions in five industries: transportation, cultural industries, broadcasting, and uranium; financial services have separate ownership restrictions requiring that they be widely held. A relaxation of these regimes would expose Canadian firms to more competition and could lead to more foreign headquarters being established in Canada.

Research shows that headquarters agglomerate in urban centers. The infrastructure that makes these centres liveable and that allows them to be linked to other urban centres (through good airports, roads and telecommunication infrastructure) is a critical factor in attracting headquarters. One approach would be to allow cities to obtain other sources of secure funding beyond property taxes and user fees. Granting cities an improved ability to provide for their own infrastructure, as do many American cities, would go some way to making them attractive as centres for headquarters, which could stimulate the creation of new headquarters, and, in some instances, the movement of existing headquarters to our major cities.

Finally, The Department of Foreign Affairs and International Trade (DFAIT) is actively involved in 'selling' Canada to foreign firms through its Invest in Canada bureau. The bureau is beginning to make good use of market intelligence to target foreign companies who may be interested in establishing headquarters in Canada. There is room for the bureau to more systemically develop leads from this market intelligence and to actively pursue these. Often times Canada may be beneath the radar of foreign firms and a well organized promotional effort can pay dividends. Canadians are often averse to trumpeting their expertise. But that trumpeting will be required more and more in order for it to distinguish itself in a world of constantly evolving global value chains. Promoting our expertise, can help increase Canada's share of corporate headquarters and its role in global value chains.

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Global Value Chains, Foreign Direct Investment, and Taxation

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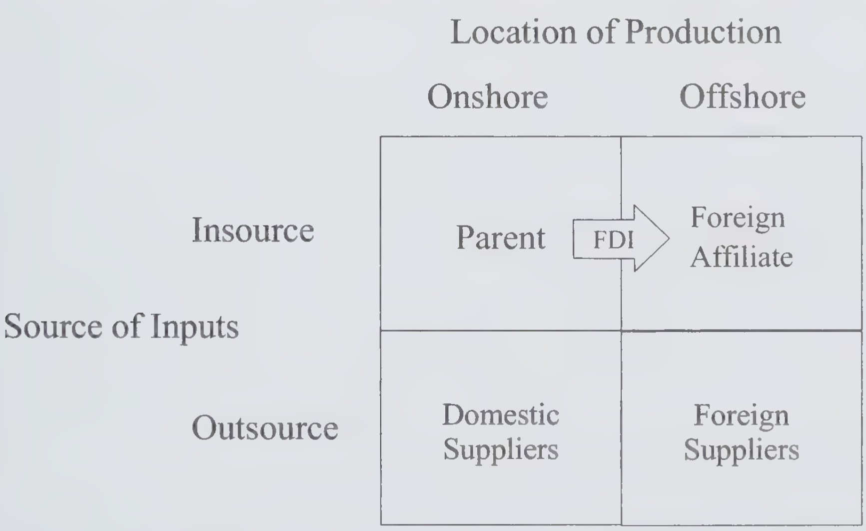
1.0 Introduction

This research volume is concerned with the causes and consequences of global value chains—the fragmentation of production across firms and international boundaries. Figure 1 provides a schema for thinking about these phenomena. The total value of inputs used in producing a given level of output can be represented by the large box. Some or all of the intermediate inputs used in producing the final product can be produced within the firm (insource) or purchased from another firm (outsource). These inputs can be obtained within the domestic economy (onshore) or from abroad (offshore). The box labelled "Parent" represents the inputs or tasks that are performed by the firm which controls production of the final product. Some inputs or tasks can be purchased at arms length from other firms operating in the domestic economy. These inputs are represented by the box labelled "Domestic Suppliers". Alternatively, a firm can obtain some of its intermediate inputs offshore. Inputs supplied by a foreign subsidiary are represented by the box labelled "Foreign Affiliate". This source of inputs gives rise to foreign direct investment (FDI). Alternatively, the firm could obtain inputs from an outside firm operating in another country, which is represented by the box labelled "Foreign Suppliers".

Figure 1: Location and Sources of Inputs in the global value chain



[*] I would like to thank Erik Ens, Johannes Becker, Theiss Buettner, seminar participants at CESifo in Munich, and anonymous referees for their comments on preliminary drafts of this chapter.

From Figure 1 we can see that the role of FDI in the global value chain will be determined by the boundaries defining the production by the "Parent", "Domestic Suppliers", and "Foreign Suppliers" in the global value chain. Recently, trade economists have made important advances in explaining the determinants of these boundaries. See for example Grossman and Helpman (2002), Antras (2003), Helpman, Melitz, and Yeaple (2004), and Antràs and Helpman (2004), Helpman (2006), Baldwin and Robert-Nicoud (2006), Antràs, Garicano, and Rossi-Hansberg (2006), and Grossman and Rossi-Hansberg (2008).

Rather than deal with the wide range of forces that are bending and stretching the links in the global value chain, this chapter focuses on one issue—the effect of taxation on the volume and location of FDI by multinational enterprises (MNEs). The recent models developed by the trade economists analyze some of the forces shaping the global value chain, but these models have ignored the role that taxation may be playing. On the other hand, public finance economists have generally ignored the trade economists' models of FDI and outsourcing. This chapter takes up the challenge of linking the two fields. We begin in Section 2 by developing a theoretical model of the effects of taxes on FDI within a modified version of the Grossman and Rossi-Hansberg (2008) (GRH) task trading framework. Then in Section 3 we survey the empirical literature on taxation and FDI from the perspective of the task trading framework. The final section of the paper briefly discusses the implications of global value chains for tax policy.

2.0 A Model of Global Value Chains, FDI, and Taxation

Intra-firm trade is an important component of world trade and is intimately connected with FDI.[1] However, most theoretical models of the effects of taxation on FDI treat capital flows between countries as if they were portfolio investments rather than part of an MNE's global value chain. In this section, we use a modified version of the GRH framework to model the effects of taxes on the flow of intermediate inputs between a parent and its foreign subsidiary. [2] Section 2.1 provides a brief overview of a modified version of the GRH task trading model. Then in Section 2.2, we use this model to analyze the effects of tariff reductions on trade and FDI. In Section 2.3, the effect of host and home country corporate income taxes (CITs) on FDI is decomposed into a "shore" and a "scale" effect. The analysis highlights the important role that the transfer prices used to value intra-firm trade play in determining the effects of a CIT rate increase on FDI. Our analysis indicates a CIT rate increase often has ambiguous shore and scale effects. Therefore, in Section 2.4 we present some computations of the tax sensitivity of FDI under a range of parameter values (including assumptions about transfer prices) to give some indication of the direction and magnitudes of these effects. In Section 2.5 we consider two extensions of the model. First, we consider an MNE which operates in three countries and how their tax rates affect the allocation of tasks among these countries. Later in that section, we assume that the tasks vary in their capital intensity and allow the MNE to contract with foreign suppliers for the performance of some tasks. Aspects of international taxation, such as double dip financing arrangements, may give an MNE's

[1] Antras (2003) notes that roughly one third of world trade is intra-firm trade. Around 80 percent of Canada's trade with the United States is intra-firm trade.

[2] Becker, Fuest and Riedel (2009) also use the GRH task trading framework to analyze the effects of taxes on FDI.

foreign subsidiary a lower cost of capital than domestic firms in the host country, giving a foreign subsidiary an advantage in performing capital intensive tasks. This may help to explain why MNEs tend to import labour intensive intermediate inputs from foreign suppliers, while capital intensive intermediate inputs are obtained through intra-firm trade with foreign affiliates. Section 2.6 concludes with some predictions from the trading in tasks model about the effects of taxes on FDI and the global value chain.

2.1 A Task Trading Model with Taxes

As in the original GRH model, we assume that the tasks involved in producing a unit of output can be indexed by $i \in \lfloor 0,1 \rfloor$. For simplicity, we treat i as a continuous variable. The MNE can perform the tasks in an affiliate operating in a foreign country or in the parent company in the MNE's home country. The after-tax cost of performing task i by the affiliate is given below:[3]

$$c_a(i) = (\alpha_L(1-u_a)w_a + \alpha_K \rho_a)\beta t(i) = c_a \beta t(i) \tag{1}$$

where:
α_L is the amount of labour required to produce one unit of task i;
u_a is the corporate income tax rate in the host country where the affiliate is located;
w_a is the wage rate paid by the affiliate in the host country;
α_K is the amount of capital required to produce one unit of task i;
ρ_a is the after-tax cost of capital for the affiliate in the host country (to be defined in a later section);
t(i) is the cost of coordinating task i in the affiliate by the MNE;
β is a shift variable reflecting changes in the cost of coordinating tasks in the affiliate.

It is assumed that the activities can be ranked in terms of their coordination cost and that $t'(i) > 0$.[4] In this version of the GRH model, we make the simplifying assumptions that the input coefficients are fixed (there is no substitution of labour for capital) and the same for each task. (In Section 2.5, we relax the latter assumption and allow the capital intensity of the tasks to vary.)

The after-tax cost of performing the tasks in the home country is:

$$c_h(i) = (\alpha_L(1-u_h)w_h + \alpha_K \rho_h) = c_h \tag{2}$$

where:
u_h is the corporate income tax rate in the home country;
w_h is the wage rate paid by the MNE in the home country;
ρ_h is the after-tax cost of capital for the MNE in the home country.

[3] The GRH model does not contain taxes and in their paper the inputs used to generate tasks are high and low skilled labour because they were interested in the effects of outsourcing on the home country's labour market.

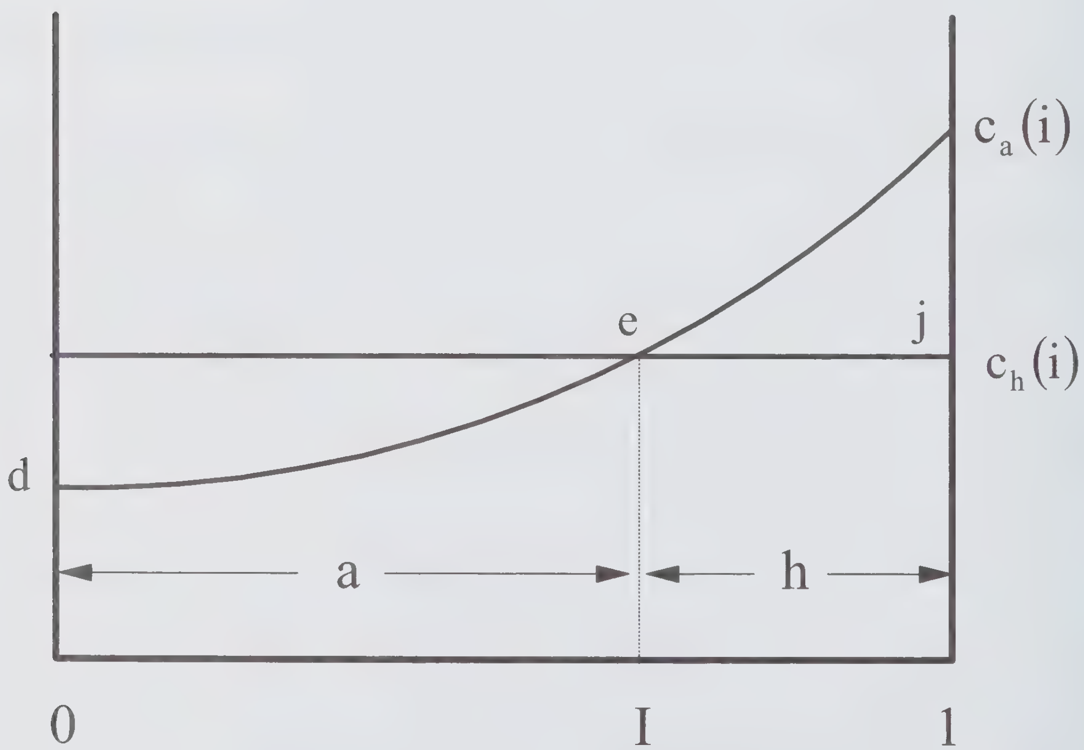
[4] The GRH model assumes that tasks are non-sequential and can be combined in any order. See Harms, Lorz, and Urban (2009) for a task trading model with sequential tasks.

To simplify the analysis, we have assumed that each task can be produced at a constant after-tax marginal cost, c_h, by the parent in the home country.

Note that α_L and α_K are the same for $c_a(i)$ and $c_h(i)$. This reflects the key idea in the GRH model that the MNE is able to transfer technology across international boundaries and use the same technology in both the affiliate and the parent corporation. The differences in the costs of performing tasks in the affiliate and the parent are due to differences in the after-tax costs of labour and capital in the host and home countries and the coordination costs that are incurred in performing the tasks in the affiliate located in the host country.

The MNE allocates tasks between the affiliate and the parent in order to maximize its total after-tax profits. In the absence of taxes and assuming $c_a(0) < c_h$, the MNE would allocate tasks from 0 to I to the affiliate, such that $c_a(I) = c_h(I)$. This situation is illustrated in Figure 2. The symbol I represents the fraction of the tasks that are performed in the affiliate. The tasks from I to 1 are undertaken by the parent in the home country because of the high cost of coordinating these activities in the affiliate. Reductions in communication and coordination costs would be reflected in a reduction in the value of the shift parameter, β, which would lead to a downward shift in the $c_a(i)$ curve and an increase in the range of the tasks that would be performed in the affiliate.

Figure 2: The GRH Task Trading Model



The marginal cost of producing a unit of output is equal to the area under the $c_a(i)$ from 0 to I plus the area under the c_h curve from I to 1, or the area dej in Figure 2, and is given by the following equation:

$$MC(I) = MC_a(I) + (1 - I)c_h \quad \text{where} \quad MC_a(I) = \int_0^I c_a \beta\, t(i)\, di \tag{3}$$

Let Q be total output of the final product. The total foreign direct investment by the parent in the affiliate is:

$$FDI = \alpha_K \cdot I \cdot Q \tag{4}$$

It is assumed that the MNE has some monopoly power in the market for its product and that the demand for its product is given by:

$$Q = Ap^{\varepsilon} \qquad A > 0,\ \varepsilon < -1 \tag{5}$$

where A reflects the size of the market for the MNE's product, p is the price of the product, and ε is the price elasticity of demand.

It will be useful to distinguish between changes in the tax systems of the host and home countries that affect FDI through changes in I, holding Q constant, and through changes in Q, holding I constant. We will use the terms *shore effect* to refer to changes in the range of tasks undertaken in the affiliate, and *scale effect* to refer to the effects of changes in the cost of the labour and capital in both countries on total production and therefore the need for investment in the affiliate. The corporate income tax rates in both the host and home countries will affect the level of FDI and intra-firm trade in intermediate inputs in complex ways. However, before analyzing these effects, however, we will explore the effects of tariff reform on FDI and the volume of intra-firm trade.

2.2 The Effects of a Tariff Reduction on FDI and Exports

In order to sell its product in a foreign market, a firm can either export the product to the foreign country or it can set up a subsidiary and produce the product in the foreign market. In this traditional view, FDI is a substitute for exports from the home country.[5] For example, Levitt (1970, p.159) claimed that US FDI in Canada and other countries after World War II was "a means of jumping tariff and other barriers to trade erected in the 1930s…." However, since the 1950s, the average tariff rates imposed by Western countries have fallen by over 20 percentage points, stimulating trade, but at the same time FDI has also increased.[6] Therefore the notion that FDI is a substitute for exports seems to be inconsistent with the empirical evidence which indicates that FDI and trade are positively correlated. We can use the model to investigate under what conditions a tariff reduction (a move to free or freer trade) reduces or increases the level of FDI.

In this section of the paper we assume $u_a = u_h = 0$ in order to focus on the effect of tariff reductions on FDI. The only tax levied by the host country is a tariff, τ_a, on imports from the home country. This tariff applies to both the final product or the intermediate products imported from the home country.

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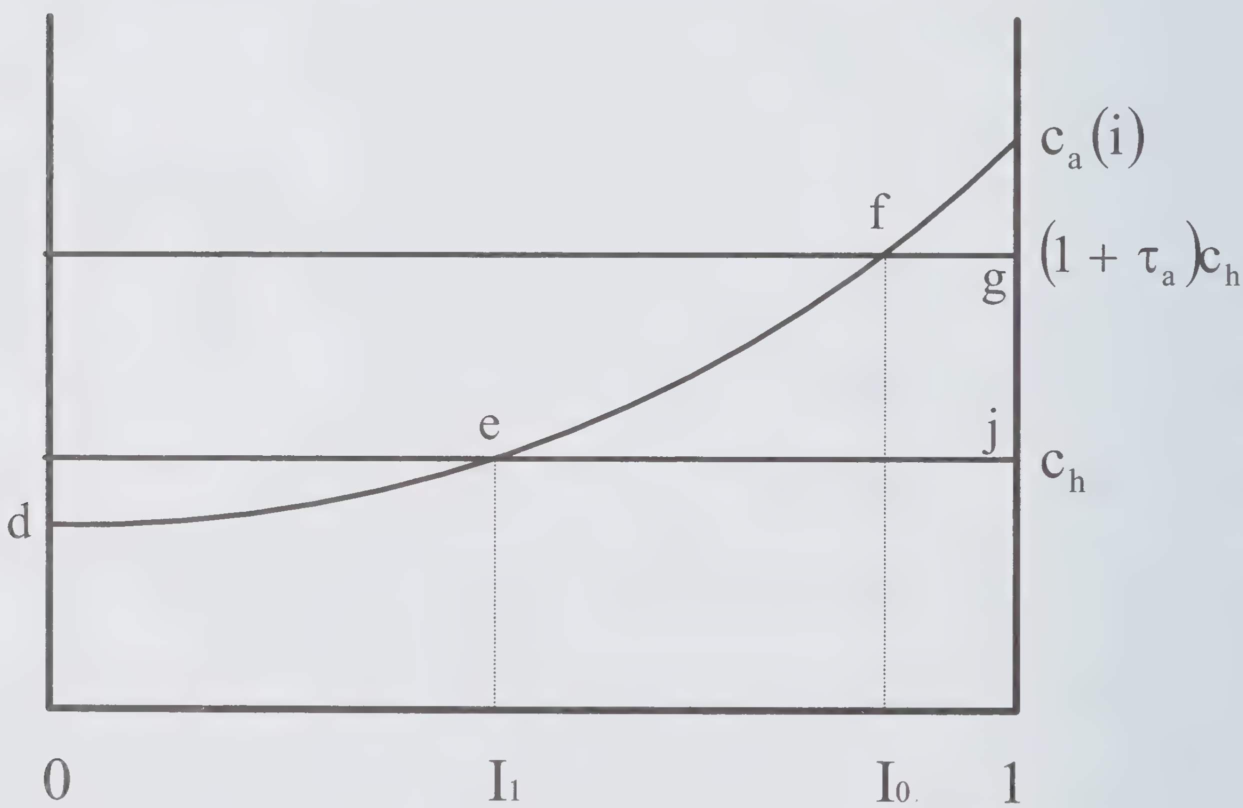
[5] See Head and Ries (2004) and Caves (2007, pp.35-42) for a discussion of these issues. See also Kemsley (1998) who finds that foreign income tax affects export decisions by US multinationals.

[6] See OECD (2007a, Table 1.1 page 14 and Figure 2.1 page 26)

In Figure 3, it is assumed that the tariff is not prohibitive and that the initial FDI is determined by the condition $c_a(I_0) = (1+\tau_a)c_h$. If the tariff on imports from the home country is eliminated, the fraction of tasks that will be conducted in the host country will decline to I_1. This would directly reduce FDI and increase of exports intermediate goods from the home country, which is consistent with the view that FDI and exports are substitutes. However, the reduction in the tariff will reduce the marginal cost of production from MC_0, which is equal to the area defg, to MC_1, which is equal to the area dej. This will induce the MNE to cut the price of its final product to expand sales, which will imply an increase in the amount of capital invested in the affiliate. Thus the tariff reduction will have an ambiguous effect on FDI because the shore effect, which reduces FDI, will be offset by the scale effect caused by the reduction in the marginal cost of production.

Figure 3: The Effect of a Tariff on the Allocation of Tasks in an MNE



To further investigate these effects, we will define an index of the relative level of FDI with free trade compared to the situation where a tariff is imposed on imports from the home country:

$$\frac{FDI_1}{FDI_0} = \frac{I_1}{I_0} \cdot \left(\frac{MC_1(I_1)}{MC_0(I_0)} \right)^{\varepsilon} \qquad (6)$$

where $I_1 < I_0$ and $MC_1 < MC_0$. Note that the scale effect will be larger the more elastic the demand for the MNE's product, and therefore we would expect that free trade

will tend to promote both FDI and trade in intermediate products when the demand for the final product is relatively elastic.

In order to gauge the relative importance of these two effects, we have adopted the following functional form for the coordination cost function:

$$t(i) = e^{mi} \qquad m > 0 \tag{7}$$

With this coordination cost function:

$$I_0 = m^{-1} \ln\left(\frac{(1+\tau_a)c_h}{\beta c_a}\right) \tag{8}$$

$$I_1 = m^{-1} \ln\left(\frac{c_h}{\beta c_a}\right) \tag{9}$$

$$MC_0 = \beta c_a\left(\frac{e^{mI_0} - 1}{m}\right) + (1 - I_0)(1 + \tau_a)c_h \tag{10}$$

$$MC_1 = \beta c_a\left(\frac{e^{mI_1} - 1}{m}\right) + (1 - I_1)c_h \tag{11}$$

Table 1 shows computations of relative FDI and exports with the elimination of a 20 percent tariff on imported intermediate inputs for various values of ε and combinations of m and β which determine the slope of the t(i) curve. In these computations, $c_a = c_h = 1$. With $m = 0.5$, the t(i) curve is almost linear. In the first row with $\beta = 0.882$, a 20 percent tariff implies that $I_0 = 0.62$ and with free trade $I_1 = 0.25$, indicating a relatively large shore effect. With free trade and $\varepsilon = -1.5$, FDI declines to 47.9 percent of its pre-free trade value, while home country exports more than double. With this set of parameter values, FDI always declines if $\varepsilon > -8.32$. In general, these calculations illustrate a case where exports are highly responsive to the elimination of the tariff and are a substitute for FDI.

The effect of a tariff reduction depends on the slope of t(i) curve. With $m = 4$, the t(i) curve is steeper, resulting in a smaller change in I in response to the elimination of a 20 percent tariff on host country's imports. In the fourth row, free trade only reduces the input share of the affiliate from 0.30 to 0.25, indicating a relatively small shore effect. The elimination of the tariff increases FDI because the reduction in cost, and consequently the reduction in the price of the product, boosts the scale of production and the amount of capital invested in the affiliate. With these parameter values, FDI increases as long as $\varepsilon < -1.13$. When demand for the product is highly price elastic, FDI more than doubles with free trade. These calculations illustrate a situation in which FDI and exports from the home country are complementary in the sense that free trade promotes both FDI and exports of intermediate inputs. This latter case may help to explain the empirical studies

which find that FDI and trade are complementary if one of the driving forces is the reduction in tariffs on intermediate inputs by the host country.[7]

Table 1: The Effects on FDI and Home Country Exports of Eliminating a 20 Percent Tariff

			FDI_1/FDI_0			X_1/X_0	
			ε			ε	
			-1.5	-3	-6	-1.5	-3
I_0	I_1	β	m = 0.5				
0.62	0.25	0.882	0.479	0.564	0.779	2.291	2.694
0.86	0.50	0.779	0.636	0.701	0.85	4.056	4.467
1.00	0.75	0.687	0.772	0.793	0.838	∞	∞
			m = 4.0				
0.30	0.25	0.368	1.057	1.320	2.061	1.330	1.662
0.55	0.50	0.135	1.105	1.333	1.939	1.327	1.601
0.79	0.75	0.050	1.077	1.231	1.609	1.396	1.596

2.3 The Effects of Corporate Income Tax Rates on FDI

Corporate income tax rates affect the after-tax cost of capital in the home and host country. In this paper, we use the following standard specification for the after-tax cost of capital for the affiliate taxes which ignores withholding taxes and the various ways in which MNEs can structure the financing of their affiliates, such as using double dip arrangements:[8]

$$\rho_a = (r_a + \delta)(1 - \phi)\left[1 - u_a \frac{a}{r_a + a}\right] \tag{12}$$

where r_a is the opportunity cost of funds invested in the affiliate (to be defined below), δ is the economic rate of depreciation, φ is the investment tax credit rate, and a is the rate of depreciation for tax purposes (capital cost allowance rate). The opportunity cost of funds is given by the after-tax return required by investors, or:

$$r_a = (1 - u_a)b\iota + (1 - b)\rho_e \tag{13}$$

[7] Antràs and Caballero (2009) also show that trade liberalization can make capital flows and trade complements in a model based on differences in financial market development between countries. Removing trade barriers in their model increases the return to capital in countries with under-developed financial sectors, thereby increasing both trade and capital flows. Their model does not involve FDI or trade in intermediate inputs by multinationals, which drives the possibility of complementarity of trade and FDI in our modified version of the GRH model.

[8] See OECD (2007b), Dahlby (2008), and Chen and Mintz (2008) on how the cost of capital invested in foreign affiliates is affected by these types of financing mechanisms. Arnold (2009, pp. 256-259) contains a description of how double dip financing can be structured by an MNE.

where b is the fraction of the investment that is financed by debt, ι is the interest rate on debt used to finance the FDI, and ρ_e is the opportunity cost of funds for shareholders. Note that the user cost of capital for the affiliate, $ucc_a = \rho_a/(1 - u_a)$. It is assumed that the ucc_a is increasing in u_a.[9]

The corporate income tax also affects the after-tax revenues generated by sales of the final product, as well as the rate at which the intermediate inputs can be deducted from taxable income. Consequently, we need to consider two case—one where the sales of the final product are attributed to the affiliate, and a second case where the sales of the final product are attributed to the parent.

Case 1: Final Product Sales by the Affiliate10

In this case, we assume the good or service produced by the MNE is sold in the host country, or in a third country, and the revenues generated by the sale of the MNE's product is attributed to the affiliate. The parent company exports intermediate inputs or tasks to the affiliate, and this will give rise to transfer payments from the affiliate to the parent. Later, we will discuss the valuation of the tasks performed by the parent, but for the time being we will represent the total transfer payments from the affiliate to the parent by P(1 – I)Q, where P is the transfer price that would be assigned to a unit of the final product if it were exported from the parent to the affiliate. We assume that the total transfer payment is proportional to the sales of the final product and based on the fraction of the inputs provided by the parent. It is best to think of P(1 – I)Q as the transfer payment for a bundle of services or components and not a payment for a specific task.

The after-tax profit of the affiliate is:

$$\Pi_a = (1 - u_a)R(Q) - (1 - u_a)P \cdot Q \cdot (1 - I) - Q \cdot MC_a(I) \tag{14}$$

where R(Q) is the revenue generated by the sale of the product. The after-tax profit of the parent is:

$$\Pi_h = ((1 - u_h)P - c_h)(1 - I)Q \tag{15}$$

The transfer payment for the tasks performed by the parent is a deduction for the affiliate and represents the taxable income of the parent. Consequently the MNE's total after-tax profit is:[11]

$$\Pi = \Pi_a + \Pi_h = (1 - u_a) R(Q) + \Delta u \cdot P \cdot Q \cdot (1 - I) - MC(I) \cdot Q \tag{16}$$

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[9] Also note that the marginal effective tax rate ($METR_a$) can be is related to the ucc_a as follows: $METR_a = (ucc_a - (i + \delta))/(ucc_a - \delta)$.

[10] Mankiw and Swagel (2006, p. 22) note that only "11 percent of the total output of US firms' foreign affiliates goes to the US market. Instead, 65 percent goes to the local market—the same country as the affiliate—while another 24 percent goes to third party foreign markets." It is not known whether there is a similar distribution of sales by Canadian foreign affiliates.

[11] It is assumed that the home country exempts dividends from the active business income of the foreign subsidiary, and no additional is tax levied by the home country on the income earned by the foreign subsidiary. Most of the dividend income from foreign subsidiaries of Canadian corporation is treated in this way.

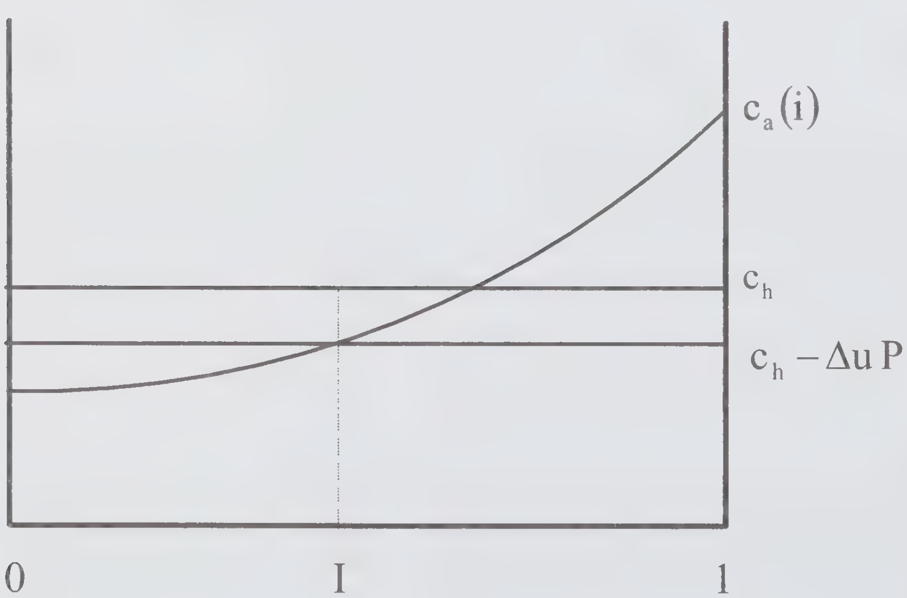
where $\Delta u = u_a - u_h$ is the CIT rate differential between the host and the home country and MC(I) is given in (3). The MNE's total after-tax profits are increasing (decreasing) in the transfer payments made by the affiliate if u_a is greater than (less than) u_h. We will discuss the determination of the transfer price in this model later in this section, but for moment we will take P as given.

The MNE maximizes its after-tax profits through its choice of I and Q. Taking the partial derivative of Π with respect to I, and the optimal allocation of tasks within the MNE is determined by the following condition:[12]

$$c_a(I) = c_h - \Delta u \cdot P \tag{17}$$

This condition describing the optimal source of the tasks is illustrated in Figure 4 where it is assumed that $\Delta u > 0$. Task I can be performed at an after-tax cost of c_h in the home country, which exceeds the after-tax cost of performing the task in the host country, $c_a(I)$. However, because of a positive tax rate differential, exporting task I to the affiliate results in a tax deduction in the host country at the rate u_aP, which is greater than the additional tax imposed on the income received by the parent in the home country, u_hP. This reduces the total after-tax cost of performing the task at home to the point where it is the same as the after-tax cost of performing it in the host country. The above condition indicates that tax rate differentials between host and home countries can influence the allocation of tasks within the MNE through their effects on the after-tax costs of labour and capital in the two countries and through the transfer price. An important contribution of this model is that it shows how the allocation of tasks depends on the transfer prices that are adopted for intra-firm trade if there is a tax rate differential between host and home countries.

Figure 4: The Optimal Allocation of Tasks in an MNE when the Host Country CIT Rate Exceeds the Home Country CIT Rate



[12] This condition for the optimal allocation of tasks was derived by Becker, Fuest, and Riedel (2009). A similar condition was derived by Horst (1971) for the optimal allocation of production in a horizontal MNE with plants in more than one country.

The profit-maximizing level of output for the MNE is determined by the following equation:

$$(1 - u_a)\frac{\partial R}{\partial Q} + \Delta u(1 - I)P = MC(I) \tag{18}$$

At the optimal output level, after-tax marginal revenue of the affiliate, $(1-u_a)\partial R/\partial Q$, plus the additional after-tax profit resulting from producing an additional unit of output through the transfer price mechanism, $\Delta u(1-I)P$, is equal to the marginal after-tax cost of producing the product, MC(I). Consequently, if there is a positive tax rate differential between the host and the home country, the transfer price mechanism will increase output and FDI, and this effect will be larger the higher the transfer price.

From (18), the profit-maximizing price for an MNE's product is:

$$p = \left(\frac{\varepsilon}{1 + \varepsilon}\right)\left[\frac{MC(I) - \Delta u(1 - I)P}{1 - u_a}\right] \tag{19}$$

where the expression in round brackets is the optimal mark-up rate, which is lower the more elastic the demand for the MNE's product, and the expression in square brackets is the before-tax marginal cost of production, $MC(I)/(1 - u_a)$, less the transfer price effect, $\Delta u(1 - I)P/(1-u_a)$. Thus a positive tax rate differential, holding I constant, will tend to lower the profit-maximizing price of the product, and this effect will be larger the higher the transfer price for the tasks performed by the parent. The total output of the MNE will be:

$$Q = A\left(\frac{\varepsilon}{1 + \varepsilon}\right)^{\varepsilon}\left[\frac{MC(I) - \Delta u(1- I)P}{1 - u_a}\right]^{\varepsilon} \tag{20}$$

and from (4) total FDI is:

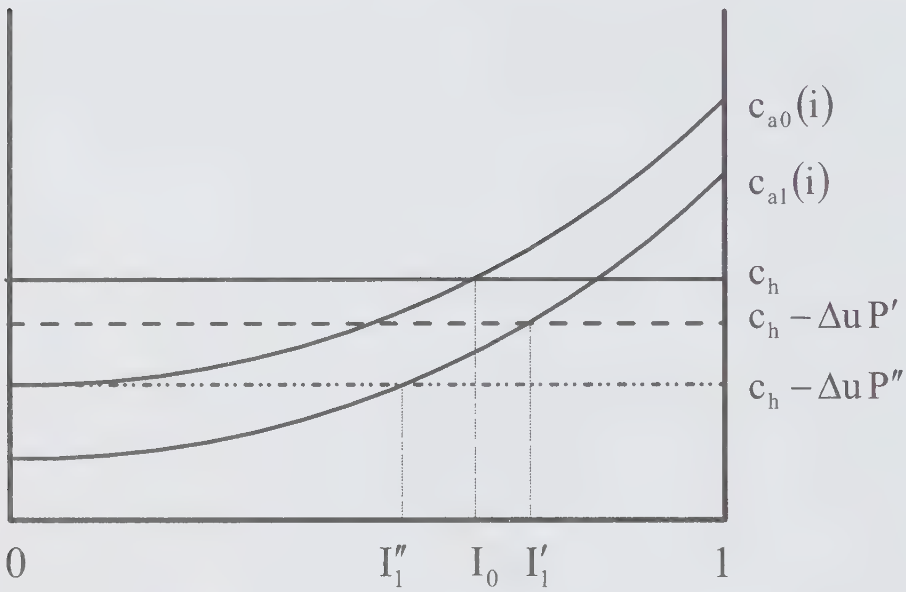
$$FDI = \alpha_K \cdot A \cdot I \cdot \left(\frac{\varepsilon}{1 + \varepsilon}\right)^{\varepsilon}\left[\frac{MC(I) - \Delta u(1- I)P}{1 - u_a}\right]^{\varepsilon} \tag{21}$$

where I is determined by the condition in (17).

We can now analyze the effects of an increase in the host or the home country's CIT rate. To simplify the analysis, we assume that initially the host and home countries impose the same CIT rate, and therefore $\Delta u_0 = 0$ and I_0 is the fraction of the tasks that are initially performed in the affiliate. Figure 5 shows that an increase in u_a has an ambiguous shore effect. An increase in u_a, holding u_h constant, reduces the after-tax cost of performing the tasks in the affiliate, and the $c_a(i)$ curve shifts down to $c_{a1}(i)$, which tends to increase the range of tasks performed in the affiliate and to increase FDI. However, the increase in u_a creates a positive tax rate differential between the host and home countries, $\Delta u_1 > 0$, and

this tends to lower the net after-tax cost of performing tasks in the home country. If the transfer price is relatively low, such as P' in Figure 5, the shore effect of the increase in u_a is positive. However, with a higher transfer price, such as P'', the shore effect is negative and tends to reduce FDI. This illustrates the key importance of the transfer price for determining whether the shore effect promotes or inhibits FDI. Note that when there is a positive tax rate differential, it is in the MNE's interest to use a high transfer price. This suggests that if MNEs have considerable scope in setting the transfer price, the shore effect of an increase in the host country's CIT rate will tend to reduce FDI.

Figure 5: The Shore Effect of an Increase in the Host Country CIT Rate



The scale effect depends on how the increase in u_a affects the MNE's before-tax marginal cost of production, $(MC(I) - \Delta u(1-I)P)/(1-u_a)$. Holding I constant at I_0, the change in the pre-tax marginal cost of production from an increase in u_a is:

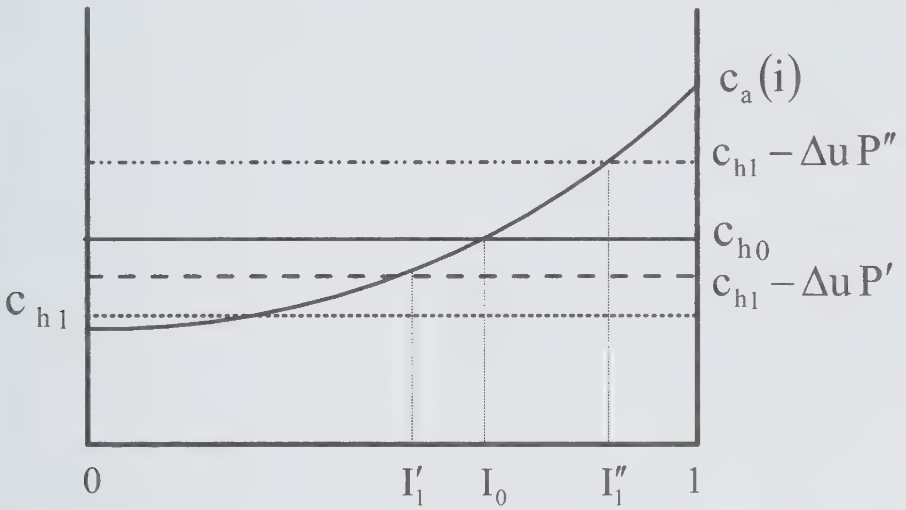
$$\Delta PTMC = \left(\frac{C_1(I_0)}{1-u_{a1}} - \frac{C_0(I_0)}{1-u_{a0}}\right) - \left[\frac{u_{a1}-u_{a0}}{1-u_{a1}}\right](1-I_0)P \tag{22}$$

where it is assumed that $u_{a0} = u_h$. The first term in round brackets is positive since we are assuming that the user cost of capital is increasing in the host country's tax rate. The second term is also positive and is larger when the transfer price is higher. Therefore, the scale effect also has an ambiguous sign and depends on the transfer price. Note that the transfer price has offsetting impacts on FDI through the shore and scale effects. With an increase in u_a, a higher transfer price causes FDI to decline by a greater amount through the shore effect, but it tends to moderate the decline in FDI through the scale effect or to convert it into a positive effect.

An increase in the home country CIT rate, u_h, also has an ambiguous shore effect. As shown in Figure 6, an increase in u_h shifts the c_h curve down to c_{h1}. However, the tax rate differential is now negative, which raises the net after-tax cost of sourcing inputs in home

country. If the transfer price is relatively low, such as P', then more tasks will be provided by the parent, and FDI will decline with the increase in u_a. However, with a high transfer price, such as P'', the share of tasks performed by the parent will decline, and the shore effect of an increase in u_h will increase FDI. Note that in this case when u_h exceeds u_a, it is in the MNE's interest to set a low transfer price, and the shore effect of an increase in u_h will tend to reduce FDI.

Figure 6: The Shore Effect of an Increase in the Home Country CIT Rate



Case 2: Final Product Sales by the Parent

Now we will consider the case where the sales of the final product are in the home country, or in a third country with the revenues attributed to the parent. The foreign affiliate exports intermediate inputs or tasks to the parent, and this gives rise to transfer payments from the parent to the affiliate. The transfer payment for the tasks performed by the affiliate is a deduction for the parent and represents the taxable income of the affiliate. The after-tax profits of the affiliate and the parent are:

$$\Pi_a = (1 - u_a)(P \cdot I \cdot Q) - MC_a(I) \cdot Q \tag{23}$$

$$\Pi_h = (1 - u_h)(R(Q) - P \cdot I \cdot Q) - c_h (1 - I)Q \tag{24}$$

The MNE's total after-tax profit is:

$$\Pi = \Pi_a + \Pi_h = (1 - u_h)R(Q) - \Delta u\, PQI - MC(I)Q \tag{25}$$

where, as before, $\Delta u = u_a - u_h$.

When the revenues are attributed to the parent and taxed by the home country, the optimal sourcing condition is the same as in the case when the revenues are attributed to the affiliate. That is, condition (17) determines the optimal I in both cases. However, the condition for profit-maximizing output is now given by:

$$\left(1-u_h\right)\frac{\partial R}{\partial Q} - \Delta u \cdot I \cdot P = MC(I) \tag{26}$$

Now a higher transfer price will reduce (increase) the profit-maximizing output of the final product if u_a is greater than (less than) u_h, with the size of this effect increasing in the transfer price. As in the previous situation, where the revenues were attributed to the affiliate, the shore effect of an increase in u_a or u_h on FDI is ambiguous.

Transfer Prices and the Effects of Corporate Income Taxes on FDI

The shore and scale effects of a CIT rate increase depend on the transfer price used to value the tasks performed either by the parent or by the affiliate. If the final product is sold by the affiliate, the MNE's after-tax profits are increasing in the transfer price P if $u_a > u_h$ and decreasing in P if $u_a < u_h$, implying that the MNE would want to set a high transfer price when the $u_a > u_h$ and a low transfer price when $u_a < u_h$. Conversely, if the final product is sold by the parent, the MNE would want a low transfer price for the tasks performed by the affiliate if $u_a > u_h$ and a high transfer price if $u_a < u_h$. There is a long established and large literature on taxation and transfer pricing by MNEs starting with Horst (1971) and Copithorne (1971). The theoretical analysis of transfer pricing and the practice and conduct of transfer pricing is covered extensively in Eden (1985, 1998), Diewert (1985), and Caves (2007, 245-249).[13] It is interesting to note that in the context of a vertically integrated MNE, which is the situation that we are modelling, Copithorne (1971) concluded that transfer prices would not affect the allocation of resources within the MNE. However, explicitly modelling the provision of tasks by the parent and the affiliate using the GRH framework shows that transfer prices affect the allocation of task (and consequently the level of FDI) within the MNE when there is a CIT rate differential between the home and host countries.

Developing a full model of transfer pricing decisions is beyond the scope of this paper. While an MNE has an incentive to manipulate transfer prices in response to a CIT rate differential, its ability to manipulate transfer prices may be constrained by tax officials in the home and host countries, who have conflicting interests in establishing transfer prices.[14] An aggressive transfer pricing policy may be very costly because the firm will have to use resources, such as outside consultants, to justify its transfer prices. Also, zero after-tax profits for the parent or the affiliate may place upper and lower bounds on the feasible transfer prices because tax officials may challenge the appropriateness of the transfer prices adopted by the MNE if they result in either the parent or the affiliate consistently

[13] The empirical literature on transfer pricing and profit-shifting is reviewed in Section 3.

[14] Tax motivated transfer prices may distort the allocation of resources within the MNE if they are used in decentralized decision-making. In addition, Keuschnigg and Devereux (2009, p.31) argue that transfer prices "serve an important economic function and are not merely a tool for tax minimization." They develop a model in which, in the absence of tax considerations, the optimal transfer price departs from the arm's length price in order to shift profits to the subsidiary when the firm faces constraints on financing investment because of asymmetric information. Forcing firms to use arms length prices results in a reduction in investment and production and a global welfare loss. See also Gresik and Osmundsen (2008) on the use of the cost-plus method of determining transfer prices in vertically integrated industries where there are no independent arms-length transactions and Dischinger and Riedel (2009) on the use of transfer prices to reduce the free cash flow of subsidiaries to overcome agency problems.

operating at a loss. We use this conjecture about the feasible range of transfer prices to define a Low Transfer Price scenario and a High Transfer Price scenario for each of the two cases indentified above.

In Case 1, where the sales of the final product are attributed to the affiliate, $P = c_h/(1 - u_h)$ in the Low Transfer Price scenario, which implies that the parent in the home country earns zero after-tax profits from its provision of tasks. This scenario might arise if the parent performs "standard" tasks that are also performed by other firms in competitive markets and these arms-length prices can be used to value its tasks. Alternatively, in the High Transfer Price scenario, the after-tax profit of the affiliate is zero and $P = (1 - I)^{-1}(p - MC_a(I))/(1 - u_a)$. This may be a reasonable upper bound for the transfer price because any higher price would imply that the affiliate would be operating at a loss, and this could cause tax officials in the host country to challenge the appropriateness of the transfer prices adopted by the MNE. Note that if $u_a > u_h$, the MNE would have a higher total after-tax profit with the high transfer price and would prefer the low transfer price if $u_a < u_h$.

In Case 2, where the sales of the final product are attributed to the parent, $P = MC_a(I)/[I(1 - u_a)]$ in the Low Transfer Price scenario, which implies that the affiliate earns zero after-tax profits. In the High Transfer Price scenario, the after-tax profit of the parent is zero and $P = (p - (1 - I)c_h/(1 - u_h))/I$. In this case if $u_a > u_h$, the MNE would have a higher total after-tax profit with the low transfer price and would prefer the high transfer price if $u_a < u_h$.

Table 2 shows the equations which determine the shore and scale effects for the two cases under the Low and High Transfer Price scenarios. Note that the equation determining the scale effect is the same in the Low Transfer Price scenarios whether the sales of the final product are attributed to the affiliate or the parent. Table 3 shows the predicted effects of increases in the home and host country tax rates, starting from a situation where the CIT rates are the same. The shore effect has an ambiguous sign under both transfer price scenarios when final product sales are made by either the affiliate or the parent. The scale effect is negative in the Low Transfer Price scenarios in both cases for an increase in either the home or host country CIT rate. In the High Transfer Price scenario, the scale effect of an increase in either the home or host country CIT rate is always ambiguous.

Table 2: The Equations Determining of the Shore and Scale Effects

	Case 1: Sale of the Final Product Attributed to the Affiliate	
	Shore effect	Scale Effect
Low Transfer Price Scenario	$c_a(u_a, I) = \left(\frac{1-u_a}{1-u_h}\right) c_h(u_h)$	$Q = A \cdot \left(\frac{\varepsilon}{1+\varepsilon}\right)^{\varepsilon} \left[\frac{MC_a(u_a, I)}{1-u_a} + \frac{(1-I)\, c_h(u_h)}{1-u_h}\right]^{\varepsilon}$
High Transfer Price Scenario	$c_a(u_a, I) = c_h(u_h) - \frac{u_a - u_h}{1-I} \cdot \left(p - \frac{MC_a(u_a, I)}{1-u_a}\right)$	$Q = A \cdot \left(\frac{\varepsilon}{1+\varepsilon}\right)^{\varepsilon} \cdot \left[\frac{\frac{1-u_h}{1-u_a} \cdot \frac{MC_a(u_a, I)}{1-u_a} + (1-I)\frac{c_h(u_h)}{1-u_a}}{\frac{1+\varepsilon}{\varepsilon} + \frac{u_a-u_h}{1-u_a}}\right]^{\varepsilon}$

	Case 2: Sale of the Final Product Attributed to the Parent	
	Shore effect	Scale Effect
Low Transfer Price Scenario	$c_a(u_a, I) = c_h(u_h) - (u_a - u_h) \cdot \left(\frac{1}{I} \cdot \frac{MC_a(u_a, I)}{1-u_a}\right)$	$Q = A \left(\frac{\varepsilon}{1+\varepsilon}\right)^{\varepsilon} \left[\frac{MC_a(u_a, I)}{1-u_a} + \frac{(1-I) \cdot c_h(u_h)}{1-u_h}\right]^{\varepsilon}$
High Transfer Price Scenario	$c_a(u_a, I) = \left[\frac{I - u_h + (1-I)\, u_a}{I \cdot (1-u_h)}\right] \cdot c_h(u_h) - \frac{u_a - u_h}{I} \cdot p$	$Q = A \cdot \left[\frac{\frac{MC_a(u_a, I)}{1-u_h} + \left(\frac{1-u_a}{1-u_h}\right)\frac{(1-I) \cdot c_h(u_h)}{1-u_h}}{\frac{1+\varepsilon}{\varepsilon} - \frac{u_a-u_h}{1-u_h}}\right]^{\varepsilon}$

Table 3: Summary of the Effects of Increases in CIT Rates on FDI

	Case 1: Final Product Sales by Affiliate	
Scenario	**Increase in the Host Country Tax Rate, u_a**	
	Shore effect	**Scale Effect**
Low Transfer Price	Ambiguous	Negative
High Transfer Price	Ambiguous	Ambiguous
Scenario	**Increase in the Home Country Tax Rate, u_h**	
	Shore effect	**Scale Effect**
Low Transfer Price	Ambiguous	Negative
High Transfer Price	Ambiguous	Ambiguous

	Case 2: Final Product Sales by Parent	
Scenario	**Increase in the Host Country Tax Rate, u_a**	
	Shore effect	**Scale Effect**
Low Transfer Price	Ambiguous	Negative
High Transfer Price	Ambiguous	Ambiguous
Scenario	**Increase in the Home Country Tax Rate, u_h**	
	Shore effect	**Scale Effect**
Low Transfer Price	Ambiguous	Negative
High Transfer Price	Ambiguous	Ambiguous

2.4 Computation of the Semi-Elasticities of FDI with respect to CIT Rates

Because the shore effect is always ambiguous over the range of transfer prices that we are considering and because the scale effect is ambiguous in the High Transfer Price scenario, we have resorted to numerical computations to provide insights concerning the predicted effects of CIT rate increases on FDI.

Tables 4 shows calculations of the semi-elasticities of I, Q, and FDI with respect to the host country and home country CIT rates when the final product sales are attributed to the affiliate. (These semi-elasticities indicate the percentage changes in these variables for a one percentage point increase in u_a or u_h) We have calculated these semi-elasticities for a capital intensive product, where labour costs are 25 percent of the total cost of production (calculated at the host country's input prices) and a labour intensive product where labour costs are 75 percent of total costs. The computations are based on the assumption that initially both the home and the host countries' CIT rates are 0.30, and then the responses in I, Q, and FDI were calculated for a one percentage point increase in u_a or u_h.

The first row of the Table 4 shows the case where initially 25 percent of the tasks are performed by the affiliate. A one percent increase in host country CIT rate would reduce FDI by 3.57 percent in the capital intensive (CIP) case and by 1.20 percent in the labour intensive (LIP) case. Although our model does not allow us to provide an unambiguous

sign for the shore effect, in these calculations the semi-elasticity of I with respect to u_a is always negative. The semi-elasticity of Q with respect to u_a is negative (as predicted) in the Low Transfer Price scenario and positive in the High Transfer Price scenario. While the increase in output would tend to increase FDI, in these calculations the negative shore effect dominates, and the FDI declines sharply in response to the host country's tax rate increase for both capital intensive and labour intensive projects.

Table 4: Semi-Elasticities of I, Q, and FDI with respect to CIT Rates: Final Product Sales by the Affiliate

		An Increase in u_a					
		Capital Intensive Product Case			Labour Intensive Product Case		
		I	Q	FDI	I	Q	FDI
I_0	β	Low Transfer Price Scenario, $\Pi_h = 0$					
0.25	0.882	-3.29	-0.29	-3.57	-1.10	-0.10	-1.20
0.50	0.779	-1.65	-0.57	-2.21	-0.55	-0.19	-0.74
0.75	0.687	-1.10	-0.87	-1.96	-0.37	-0.29	-0.66
		High Transfer Price Scenario, $\Pi_a = 0$					
0.25	0.882	-10.53	1.84	-8.89	-8.38	2.03	-6.52
0.50	0.779	-6.70	1.52	-5.28	-5.65	1.91	-3.85
0.75	0.687	-6.69	1.11	-5.65	-6.04	1.70	-4.44

		An Increase in u_h					
		Capital Intensive Product Case			Labour Intensive Product Case		
		I	Q	FDI	I	Q	FDI
I_0	β	Low Transfer Price Scenario, $\Pi_h = 0$					
0.25	0.882	3.29	-0.93	2.33	1.10	-0.31	0.78
0.50	0.779	1.65	-0.65	0.99	0.55	-0.22	0.33
0.75	0.687	1.10	-0.35	0.75	0.37	-0.12	0.25
		High Transfer Price Scenario, Π_a=0					
0.25	0.882	11.21	-3.10	7.77	8.96	-2.49	6.25
0.50	0.779	7.55	-2.86	4.47	6.38	-2.44	3.79
0.75	0.687	11.12	-2.98	7.82	9.89	-2.70	6.92

Notes: $u_{a0} = 0.30$, $u_{h0} = 0.30$, $\varepsilon = -3$, $m = 0.5$; CIP case $\theta_{La} = 0.25$, LIP case $\theta_{La} = 0.75$

The calculations also suggest that aggressive transfer pricing may make FDI more responsive to host country tax rate increases. The MNE's after-tax profits are on average 1.4 percent higher in the High Transfer Price (HTP) scenario than in the Low Transfer Price (LTP) scenario, indicating that there is a potentially strong incentive to adopt a high transfer price when the host country's tax rate is higher than the home country's rate.

An increase in the home country CIT rate increases the fraction of tasks performed by the affiliate, but reduces the total sales of the final product because of the increase in the cost of production. However, FDI increases in response to an increase in the home country CIT rate in both and transfer price scenarios.

Table 5 shows the semi-elasticities of I, Q, and FDI with respect to the host and home country's CIT rates when the revenues from the final product are attributed to the

parent. With an increase in u_a, both I and Q decline in the capital intensive product case in both transfer price scenarios, leading to declines in FDI. With a labour intensive product, the shore effect changes sign in the Low Transfer Pricing scenario when the initial I goes from 0.25 to 0.50. However, the FDI always declines when u_a increases in the labour intensive product case.

Table 5: Semi-Elasticities of I, Q, and FDI with respect to CIT Rates: Final Product Sales by the Parent

		An Increase in u_a					
		Capital Intensive Product Case			Labour Intensive Product Case		
		I	Q	FDI	I	Q	FDI
I_0	β	Low Transfer Price Scenario, $\Pi_a = 0$					
0.25	0.882	-2.63	-0.29	-2.91	-0.42	-0.10	-0.51
0.50	0.779	-0.99	-0.57	-1.56	0.11	-0.19	-0.08
0.75	0.687	-0.47	-0.88	-1.34	0.27	-0.30	-0.03
		High Transfer Price Scenario, $\Pi_h = 0$					
0.25	0.882	-50.13	-3.41	-51.83	-40.27	-2.95	-42.03
0.50	0.779	-7.01	-2.77	-9.59	-5.82	-2.40	-8.08
0.75	0.687	-2.84	-3.03	-5.78	-2.08	-2.46	-4.49

		An Increase in u_h					
		Capital Intensive Product Case			Labour Intensive Product Case		
		I	Q	FDI	I	Q	FDI
I_0	β	Low Transfer Price Scenario, $\Pi_a = 0$					
0.25	0.882	2.58	-0.93	1.63	0.40	-0.31	0.09
0.50	0.779	0.97	-0.65	0.32	-0.12	-0.22	-0.34
0.75	0.687	0.45	-0.35	0.10	-0.27	-0.12	-0.39
		High Transfer Price Scenario, $\Pi_h = 0$					
0.25	0.882	20.75	1.06	22.03	18.87	1.68	20.87
0.50	0.779	5.95	1.46	7.49	4.91	1.90	6.90
0.75	0.687	2.58	1.79	4.42	1.87	2.03	3.94

Notes: $u_{a0} = 0.30$, $u_{h0} = 0.30$, $\varepsilon = -3$, $m = 0.5$; CIP case $\theta_{La} = 0.25$, LIP case $\theta_{La} = 0.75$.

With an increase in the home country tax rate, I increases under both transfer price scenarios in the case of a capital intensive project, while Q is negative in the LTP scenario and positive in the HTP scenario. The overall effect on FDI of an increase in the home country tax rate is positive under both transfer price scenarios in the capital intensive product case. In the labour intensive product case, the effect on I switches from positive to negative as I increases in the LTP scenario and as does the overall effect on FDI. In the conventional tax competition model, which does not incorporate input flows (other than capital) between the parent and the subsidiary, transfers prices do not play any role and an increase in the home country's tax rate causes "capital flight" which can be interpreted as an increase in FDI. Therefore, the trading in tasks model's prediction that FDI may decline with an increase in the home country tax rates is novel feature.

2.5 Extensions of the Model

The Global Value Chain with Multiple Affiliates

To this point, the model has only dealt with the case where there is a parent and one foreign affiliate. However, the classic examples of global value chains, such as the design, manufacture, and sale of a Barbie Doll, involve tasks performed in several countries.[15] In this section, we will extend the model to a case where tasks are performed by two affiliates, located in different countries, as well as by the parent in the home country. The model shows that the location of the tasks depends on the tax rates in all three countries as well as the transfer prices used to allocate profits within the MNE.

To capture the idea of a global value chain, we assume that some tasks are performed by an affiliate located in country 1 (e.g. production of basic inputs such as plastic pellets), and then this intermediate input is transferred to an affiliate located in country 2, which performs another range of tasks (e.g. manufacturing the toy) before transferring the semi-finished product to the home country where additional tasks are performed (e.g. advertising and distribution) and the final product is sold. We assume that country 1 has low after-tax labour and/or capital costs, but that the cost of coordinating tasks in this country increases rapidly, perhaps because of distance or language differences. In particular, we will assume $t_1'(I) > t_2'(I)$ where the subscript indexes the coordination costs in countries 1 and 2. The affiliate in country 1 performs the task from 0 to I_1, the affiliate in country 2 performs the tasks from I_1 to I_2, and the remaining tasks, I_2 to 1, are performed in the home country by the parent where the product is sold. The after-tax profits earned by the three units are given below:

$$\Pi_1 = (1 - u_{a1})P_1 I_1 Q - MC_{a1} \cdot Q \tag{27}$$

$$\Pi_2 = (1 - u_{a2})(P_2(I_2 - I_1) - P_1 I_1)Q - MC_{a2} \cdot Q \tag{28}$$

$$\Pi_h = (1 - u_h)(R(Q) - P_2(I_2 - I_1)Q) - c_h(1 - I_2) \cdot Q \tag{29}$$

where P_1 is the transfer price for the tasks performed by affiliate 1, P_2 is the transfer price for the tasks performed by affiliate 2, and:

$$MC_{a1} = \int_0^{I_1} c_{a1} \beta t_1(i) di \tag{30}$$

$$MC_{a2} = \int_{I_1}^{I_2} c_{a2} \beta t_2(i) di \tag{31}$$

It should also be recalled that c_{a1}, c_{a2}, and c_h are decreasing in the tax rates of their respective countries. The MNE's total after-tax profit is therefore equal to:

[15] Grossman and Rossi-Hansberg (2006, p.60) on the links in the global value chain that produces a Barbie doll.

$$\Pi = (1 - u_h)R(Q) + (u_{a2} - u_{a1})P_1 I_1 Q + (u_h - u_{a2})P_2(I_2 - I_1)Q - MC(I_1, I_2)Q \quad (32)$$

where:

$$MC(I_1, I_2) = \int_0^{I_1} c_{a1} \cdot \beta \cdot t_1(i)\, di + \int_{I_1}^{I_2} c_{a2} \cdot \beta \cdot t_2(i)\, di + (1 - I_2) \cdot c_h \quad (33)$$

Differences in the CIT rates in the three countries will affect the allocation of tasks—the location of the links in the global value-added chain. The values of I_1 and I_2 which maximize the MNE's total after-tax profits will be determined by the following conditions:

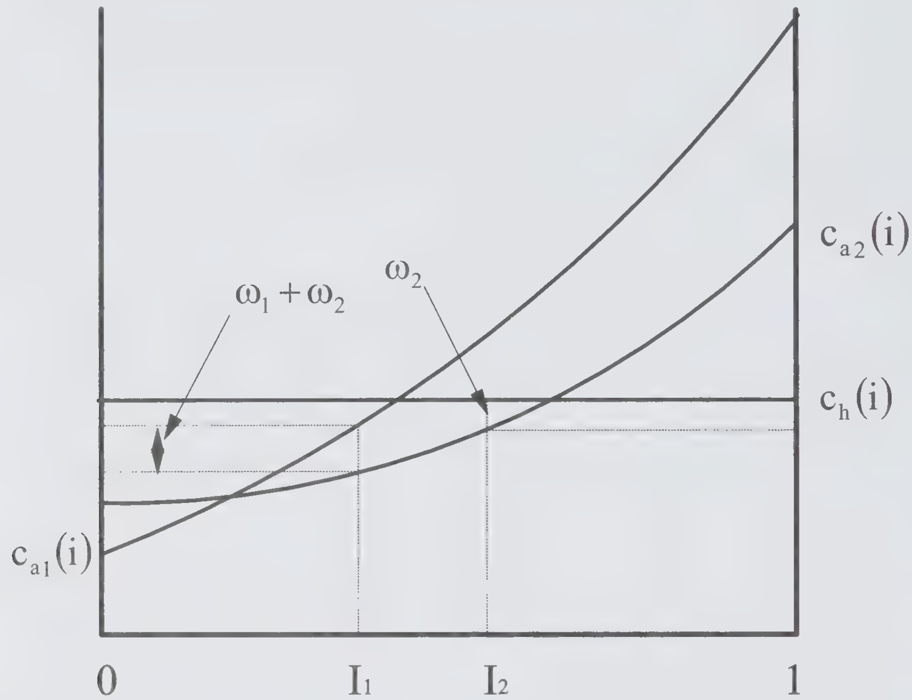
$$c_{a1} \cdot \beta \cdot t_1(I_1) - c_{a2} \cdot \beta \cdot t_2(I_1) = (u_{a2} - u_{a1}) \cdot P_1 + (u_{a2} - u_h) \cdot P_2 \quad (34)$$

$$c_{a2} \cdot (\beta \cdot t_2(I_2)) - c_h = -P_2 \cdot (u_{a2} - u_h) \quad (35)$$

For concreteness, suppose country 2 is a high tax country, with $u_{a2} > u_{a1} > u_h$. The cost of performing the marginal task in affiliate 1 will exceed the cost of performing that task in affiliate 2 by an amount that reflects the tax savings from reducing the tasks performed by affiliate 2 and increasing the tasks preformed in affiliate 1 and also by the parent. The cost of performing the marginal task in affiliate 2 will be less than the marginal cost of performing it in the home country by the parent by an amount that reflects the tax savings from earning more income in the parent and less income in affiliate 2. The slicing up of the global value chain in this situation is illustrated in Figure 7 where $\omega_1 = (u_{a2} - u_{a1})P_1$ and $\omega_2 = (u_{a2} - u_h)P_2$. Shrinking the range of activities performed in affiliate 2 increases the MNE's total after-tax profit when u_{a2} exceeds u_h. Therefore, when u_h declines relative to u_{a2}, total after-tax profits increase if the range of activities performed by affiliate 1 increases, even though affiliate 1 does not "sell" its tasks to parent.

An interesting feature illustrated by this case is that the range of tasks performed by the affiliate in country 1 depends not only on its tax rate differential with country 2, where it "sells" its tasks, but also on the tax rate differential between country 2 and the home country. Thus the MNE's FDI in country 1 depends on the tax rate differentials between the other countries as the product moves up the value-added chain. This drives home the point that the FDI by an MNE in any country depends not only on that country's tax rate, but also on the tax rates imposed by all of the countries in MNE's global value chain.

Figure 7: Allocation of Tasks Among Two Foreign Affiliates and the Parent
$u_{a2} > u_{a1} > u_h$



Outsourcing, Offshoring, and the Capital Intensities of Tasks

The model to this point has also been limited by the assumption that all tasks require the same capital-labour ratios and that the MNE cannot outsource some of its tasks. In this section, we assume that tasks vary in their capital intensity and that foreign suppliers can performance some tasks for the MNE.[16] Many complex issues affect the insource versus outsource decision including incomplete contracts, hold-up problems, searching for suitable suppliers, and protection of intellectual property.[17] In contrast to the trade literature which focuses on limited contracts in establishing the insource vs. outsource boundary, we assume that a complete contract with foreign suppliers can be signed and enforced in order to emphasize the role that the international tax system can play in determining the tasks that are outsourced to foreign suppliers and those that are performed by a foreign affiliate operating in the same country as the foreign suppliers.

We now assume that each task requires one unit of labour. Let $\alpha_{Ka}(i)$ denote the amount of capital required to perform task i by the affiliate operating in country j. The tasks are ordered in terms of increasing capital intensity and therefore $\alpha'_{Ka}(i) > 0$. We also make the "strong" assumption that coordination costs are increasing in i, perhaps because the more complex tasks are the more capital intensive tasks. Hence the after-tax cost of task i performed by the affiliate in country j is:

$$c_{aj}(i) = \left((1 - u_j)w_j + \alpha_{Ka}(i)\rho_{aj}\right)\beta t(i) \qquad (36)$$

where u_j is the CIT rate, w_j is the wage rate, and ρ_{aj} is the after-tax cost of capital of the affiliate operating in country j. The foreign suppliers of tasks in country j have the following after-tax costs of performing tasks:

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[16] We do not focus on the effects of taxes on the domestic outsourcing decision because an increase in the home or host country CIT rates should not affect the onshore outsourcing decision.

[17] See Spencer (2005) for a survey of the trade literature on modelling outsourcing decisions.

$$c_{oj}(i) = \left(\left(1 - u_j\right)w_j + \alpha_{Ko}(i)\rho_{oj}\right)\beta t(i) \tag{37}$$

We assume that the foreign affiliate and the foreign suppliers face the same wage rate and CIT rate, and that coordination costs are the same, but that there are differences in their capital requirements and their after-tax costs of capital. Specifically, we assume:

$$\alpha_{Ko}(i) \leq \alpha_{Ka}(i) \qquad \text{for} \qquad 0 < i \leq h \leq 1 \tag{38}$$

and that $\rho_{oj} > \rho_{aj}$ and $c_{oj}(0) < c_{aj}(0)$. That is, we assume that the foreign suppliers are more efficient at performing at least some range of tasks, but that they have a higher after-tax cost of capital than the foreign affiliate operating in their country. Note that the lower after-tax cost of capital is assumed to occur even when both sets of firms face the same host country CIT rate u_j. As demonstrated in OECD (2007b), Dahlby (2008), and Chen and Mintz (2008) foreign affiliates can have a lower after-tax cost of capital than a purely domestic firm through financial arrangements such as the use of hybrid securities that are treated as debt by the host country and as equity investment by the home country, or the channelling of investments through tax havens and other low tax countries in order to achieve a double deduction of interest on debt used to finance the investment in the affiliate—a so-called double dip. It is assumed that these types of financing schemes, which can significantly lower the cost of capital for FDI, are not available to the domestic firms that can perform tasks in country j.[18] Consequently, the foreign suppliers may have a cost advantage in performing a range of tasks with low capital intensity, such as task 0, but we will assume that at some capital intensity, the foreign affiliate can perform tasks at a lower after-tax cost.

Figure 8 illustrates the division of tasks between the foreign suppliers in country j, the foreign affiliate operating in that country, and the parent operating in the home country, if the $u_j = u_h$. Our assumptions lead to the not unexpected result that the MNE imports labour intensive tasks from foreign suppliers (offshore outsourcing) and relies on a foreign affiliate for more capital intensive tasks. In our example, the most capital intensive tasks are still performed by the parent in the home country because of very high coordination costs. This model is consistent with the evidence presented by Antràs (2003, p.1376) that US MNEs "…tend to import capital-intensive goods, such as chemical products, within the boundaries of their firms, while they tend to import labor-intensive goods, such as textile products, from unaffiliated parties." In his model, the problem of incomplete contracting gives rise to this pattern of trade. We have shown that this trade pattern is also consistent with foreign affiliates having a lower cost of capital than foreign suppliers because they are often able to take advantage of tax deductions for interest payments on debt in both the home and host countries.

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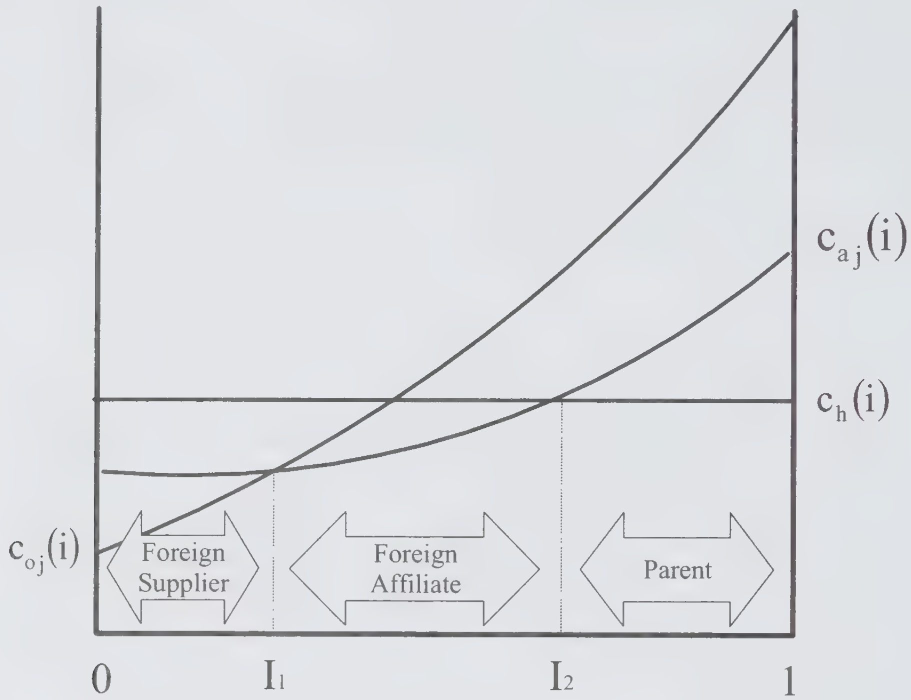
[18] For example, Chen and Mintz (2008, Table 5b, p.19) shows that the effective marginal tax rate on investment by a Canadian multinational investing in the U.K. using a Barbados conduit entity was 7.9 percent in 2008 while U.K. firm investing n its domestic market would have faced a marginal effective tax rate of 21.8 percent. Conversely, a U.K. firm using a Swiss conduit entity to invest in Canada would have faced an 11.4 percent effective tax rate compared to 24.4 percent effective rate on an investment in Canada by a domestic Canadian firm.

Figure 8: Foreign Outsourcing Versus Insourcing



How is outsourcing affected by the CIT rate differentials between the home and host country? We assume that the foreign suppliers are perfectly competitive firms that earn zero after-tax profits. The MNE can purchase tasks from 0 to I_1 from the foreign suppliers at a price which covers their pre-tax costs of production:

$$P_{oj} = \frac{1}{I_1}\frac{MC_{oj}(I_1)}{1-u_j} \tag{39}$$

It is also assumed that the final product is sold in the home country by the parent, and it pays a transfer price of P_{aj} for the tasks I_1 to I_2 performed by the foreign affiliate operating in country j. It can be shown that the optimal value for I_1, the boundary between offshore outsourcing and offshore insourcing, is determined by the following condition:

$$c_{oj}(I_1) - c_{aj}(I_1) = \frac{(1-u_j)(u_j-u_h)}{1-u_h}\frac{P_{aj}}{\beta t(I_1)} \tag{40}$$

Since the left-hand side of (40) is not affected by u_h (subject to a caveat to be discussed below), while the right-hand side is decreasing in u_h given that $u_j < 1$, a reduction in the home country CIT rate should increase offshore outsourcing compared to production by the MNE's foreign affiliates operating in the same country. This prediction assumes that ρ_{aj} does not decline when u_h declines. This seems reasonable given that a reduction in u_h will make borrowing by the parent to finance the foreign affiliate less attractive.

2.6 What Can We Learn From This Model?

In this section we discuss some of the insights concerning the effects of taxes on FDI that can be gleaned from the trading in tasks framework. While many of these insights are not unique to the trading in tasks model, its emphasis on the linkages between parents and foreign subsidiaries provides a more detailed description of the factors that influence FDI and how the tax system influences these decisions than the standard models of FDI used by public finance economists.

Predictions Regarding Inbound FDI

- FDI can be very sensitive to the host country CIT rate. The shore effect, which is highlighted in this model, generally can have a larger than the impact on the volume of FDI than changes in total output. Of course, our simulation results in Tables 4 and 5 are hypothetical and may not reflect all of the empirically relevant factors that affect FDI decisions. Still, compared to the conventional model of taxation and FDI, the trading in tasks framework suggests that FDI can be very sensitive to the host country tax rate because FDI is affected by the range of tasks that are performed by the foreign subsidiaries of MNEs.
- If the growth of FDI and the intra-firm trade in intermediate inputs is driven by reductions in communication and coordination costs, FDI may become less responsive to increases in the host country's CIT rate. This is illustrated in Tables 4 and 5 where simulations with lower values for β and higher initial values for FDI generate lower semi-elasticities for FDI with respect to the CIT rate. Again, it should be stressed that these are predictions based on particular sets of parameter values and a specific functional form for coordination costs and should not be taken as general predictions. Still, these simulation results serve as a counter example to the widely expressed belief that lower coordination and communication costs over time have made FDI more tax sensitive.
- FDI seems to be more sensitive to the host country's CIT rate when the sales of the final product are attributed to the affiliate, rather than the parent, and the MNE uses constrained profit-maximizing transfer prices.
- An increase in the host country's CIT rate has a more deleterious effect on FDI in a capital intensive sector than in a labour intensive sector because an increase in the CIT rate increases the user cost of capital because the return on equity investment is not deductible. The cost of performing tasks in the subsidiary will increase by a greater amount the more capital intensive they are, thereby having a more deleterious effect on FDI.
- A switch to transfer prices that maximize after-tax profits has an ambiguous effect on the sensitivity of FDI to the host country's CIT rate.
- FDI by vertically integrated MNEs may be more sensitive to the host country CIT rate than FDI by horizontal MNEs because the shore effect is a potentially important determinant of the tax sensitivity of FDI for a vertically integrated MNE, and it is (virtually) absent in a horizontal MNE.
- As shown by the profit-maximizing conditions in (34) and (35) and illustrated in Figure 7, FDI in any country depends not only on the host country's CIT rate, but also on the tax rates imposed by all of the countries in MNE's global value chain.

Predictions Regarding Outbound FDI

- Contrary to the predictions of the conventional tax competition model, in the trading in tasks framework a higher home country CIT rate may lead to lower outbound FDI. However, this negative effect was only observed in a few simulation results, suggesting that it may only emerge under fairly restrictive conditions. As we will see in the following section, empirical studies have found mix results concerning the effects of home country CIT rates on outbound FDI, a pattern of results which nonetheless seems more consistent with the trading in tasks framework than with the conventional model.
- Outbound FDI seems to be more sensitive to the home country's CIT rate when sales of the final product are attributed to the parent rather than the affiliate and the MNE uses constrained profit-maximizing transfer prices.
- A switch to transfer prices that maximize after-tax profits has an ambiguous effect on the sensitivity of FDI to the home country's CIT rate.

Predictions Regarding Offshore Outsourcing

- Offshore outsourcing of tasks becomes more advantageous, relative to production by foreign affiliates, when the home country's CIT rate declines, holding the host country's CIT rate constant.

In the next section we review the empirical literature from the perspective of the trading in tasks model, and in the final section we discuss some of the policy implications of this model.

3.0 Empirical Studies of FDI, Profit-Shifting, and Taxation

Many non-tax factors affect the size and location of FDI such as the size and growth rate of foreign markets, unit labour costs, legal systems and regulatory regimes, and "distance" from the home country, including language and cultural differences. While all of these factors may be important, in this survey we focus on the impact of taxation on FDI.

Over the last 30 years, a substantial body of empirical research on the effects of taxes on FDI has emerged. This literature has received wide-spread attention and has been the subject of a number of excellent surveys including Hines (1999), Gresik (2001), Gordon and Hines (2002), and OECD (2007, Chapter 2). Rather than cover the same ground as those previous surveys by providing a detailed review of the main body of literature, we will begin by summarizing the main findings of two recent literature surveys—de Mooji and Ederveen (2006) and Devereux (2007). Although these are fairly recent surveys of the empirical literature, there has recently been a veritable explosion of empirical studies of international taxation in the past 3 or 4 years which these surveys did not cover. Therefore in Section 3.2, we will review the findings of the most recent literature on taxation and FDI. Since the theoretical model developed in Section 2 has highlighted the potentially important impact that transfer pricing may have on the location of the links in the global value chain, in Section 3.3 we focus on the recent empirical literature on profit-shifting through transfer pricing and the location of MNEs' activities.

Before beginning these reviews, we should note that just as trade economists have not incorporated taxation in their models of the global value chain, so public finance economists have not based their studies of the impact of taxes on FDI on models of trade

in intermediate products. The empirical literature on taxation and FDI therefore provides little direct evidence of the effect of taxation on the global value chain.

3.1 Overviews of the Empirical Literature on Taxation and FDI

A Decision Tree Framework for FDI

Devereux (2007) contains a comprehensive review of the empirical literature on taxation and FDI. He began his survey by noting that most of the empirical research is based on a model where capital is allocated across countries to equalize its after-tax returns, and that "this model seems more suitable for describing flows of portfolio capital rather than the location and investment decision of multinational companies, which by contrast are characterised by the presence of imperfect competition and economic rent." (p.4) Devereux has argued that a better framework for thinking about how taxation influences FDI is the following decision tree that a firm faces:

1. *Whether to serve only the domestic market or to sell its product in foreign markets, and if so, whether to export a product or produce it abroad?* If the firm decides to produce abroad, this gives rise to horizontal FDI. Although not specifically considered by Devereux, we can also consider at the first stage of a decision tree, whether a firm will purchase inputs from domestic suppliers or from a foreign country and if the latter, whether to outsource offshore or to insource offshore. That latter choice gives rise to vertical FDI. The decision to serve foreign markets will be affected by both the foreign and domestic average effective tax rates, and as we have seen in Section 2, the export versus production abroad decision will be influenced by tariffs and the tax treatment of foreign source income.[19]

2. *Which foreign country or countries to produce in, given that the firm has decided to serve a foreign market by producing abroad or to produce inputs abroad?* Devereux argues that this decision will be influenced by the average effective tax rates on profits from the firm's operations in any of the foreign countries where it might operate.[20]

3. *What scale of the production to undertake in the foreign countries where production will take place?* The neo-classical model of investment predicts that the marginal effective tax rate on investment will affect the amount of capital invested.

4. *Where to realize or record profits, given the allocation of production activities in foreign countries?* Devereux points out that the realization of profits, through such means as transfer pricing of intermediate products, royalty payments for the use of assets such as patents and trademarks, and intra-corporate financing, will largely be driven by the foreign and domestic countries' statutory corporate tax rates. Recording higher profits in a country with a low tax rate will almost always involve some level of FDI, if only to establish an office in a tax haven. However, as the model in the earlier section indicated, shifting profits to affiliates in countries with low corporate tax rates may be less susceptible to detection by foreign and domestic tax officials if the target country has many legitimate transactions with affiliates in other countries. Thus research facilities, back offices, and even plants may be located in a low statutory tax rate country in order to promote profit-shifting activities. With regard to the empirical literature, Devereux (2007, p.13) notes that

[19] See Kemsley (1998) on the effect of US tax treatment of foreign source income on exports by US MNEs.

[20] The average effective tax rate (EATR) is defined as the ratio of the present value of the taxes to the present value of the income generated by a project that earns a given amount of economic rent. The EATR is a weighted average of the statutory rate and the EMTR. See the OECD (2007b) on the computation of the EATR and EMTR in the context of international taxation.

while "some papers do consider flows of capital and profit…none has attempted to create and use a measure of effective taxation of capital taking into account the possibility of profit shifting."

In Devereux's framework, the location and volume of FDI is a multi-stage decision, and the different measures of the tax rate on corporate profits—the average effective tax rate, the marginal effective tax rate, and the statutory tax rate—can all affect the final outcome. Note also that in the first and fourth stages of the decision process, both the home and host country tax rates will affect the volume and location of FDI.

A Meta Analysis of Research on FDI and Taxation

De Mooij and Ederveen (2006) provides a meta analysis of 31 econometric studies of corporate taxation and FDI published between 1984 and 2005.[21] They performed statistical analyses of the 427 estimates of the semi-elasticity of FDI with respect to corporate income tax rates from these studies to investigate common patterns in these parameter estimates.[22] (The semi-elasticity is the percentage change in the volume of FDI from a one percentage point increase in the host country's corporate income tax rate. Various measures of corporate income tax rates were used in different studies.) In broad terms, they found that the majority of semi-elasticities were between 0 to -5, with a mean semi-elasticity of -3.72 and a median of -2.91. Only slightly more than 50 percent of the 427 estimated semi-elasticities were considered statistically significant in the original studies. This indicates that the literature contains a wide range of estimates of the tax sensitivity of FDI.

Beyond summarizing previous results, de Mooji and Ederveen investigated how different aspects of the econometric studies, such as the sample period and the type of data used in the regressions, affected the parameter estimates. They did this by estimating regression equations where the dependent variable was the semi-elasticity and the explanatory variables were the characteristics of the data used in the 31 studies.

Their key findings are summarized below:

- *The home country's tax treatment of foreign source income.*[23] If the home country uses a foreign tax credit system in taxing foreign source income, FDI may be less responsive to a host country's CIT rate than it is under an exemption system (where no home country tax is levied on active business income from foreign sources) because the higher host country tax rate may be offset by a larger tax credit by the home country for firms that are in a deficit tax credit position, i.e. the host country tax rate is less than the home country tax rate.[24] However, the ability to defer the repatriation of foreign investment income may greatly reduce or eliminate the additional home country tax that may be levied under a tax credit system, effectively converting it into the equivalent of an exemption system. De Mooji and Ederveen found that there were no statistical significant differences in the semi-elasticities obtained from data based on exemption and credit countries. Also, there were no significant differences

[21] This is an extension and updating of an earlier meta analysis in de Mooji and Ederveen (2003).

[22] Recall that the semi-elasticity is the percentage change in the volume of FDI from a one percentage point increase in the host country corporate income tax rate.

[23] See Barrios et al. (2008, pp.7-10) for a description of the credit, exemption and deduction systems to relieve double taxation.

[24] Higher host country taxes under a credit system may increase FDI through merger and acquisitions because local owners are worse off while foreign owners may be shielded from the tax increase by higher home country tax credits.

in the semi-elasticities for investment funded by retained earning or transfers of funds.

- *Periphery versus core countries.* Models which incorporate agglomeration effects, such as Baldwin and Krugman (2004), predict that investment in "core regions" may be less sensitive to capital tax rates than in the "periphery" because the advantages of locating in the core, such as proximity to customers or access to thick markets for key inputs, may more than offset the impact of higher taxes on after-tax profits.[25] De Mooji and Ederveen found that the estimated semi-elasticities were higher in periphery countries, such as Canada, Australia, and the Scandinavian countries, but the differences were not statistically significant.[26]
- *Type of data.* Larger semi-elasticities were found in studies that used cross-section data compared to those based on time series or panel data. Studies that employed discrete choice data (0 or 1 for the location of FDI) had lower semi-elasticities. De Mooji and Ederveen (2006, p. 20) interpreted this to mean that "the amount of capital invested is more responsive to taxes than the location decisions themselves." They also found that FDI in new plant and equipment had higher semi-elasticities, while FDI through mergers and acquisitions had lower semi-elasticities.
- *Definitions of tax rates*: Different semi-elasticities of investment are to be expected for the different definitions of the tax rates because, as Devereux's decision tree framework indicates, the statutory tax rate, average effective tax rate, and marginal effective tax rate affect different aspects of the investment decision, such as the location, scale, or type of investment. Studies which used average or marginal effective tax rates on FDI yielded larger semi-elasticities than those that used statutory tax rates. Average effective tax rates produced the largest semi-elasticities.
- *Sample period.* Larger semi-elasticities were found in studies that used more recent data (measured by mean sample year), but the differences were not statistically significant.[27] Interestingly, they found that the semi-elasticities were higher when the studies used pre-1980 or post-1990 data. (The lower semi-elasticities that were obtained by the studies that used data from the 1980s may reflect a disruption in investment flows following the US tax reform in the mid 1980s which significantly lowered US tax rates and, with a lag, to tax cuts by many other countries.) Zodrow (2008, p.400) summarizes his assessment of the issue of whether the tax sensitivity of FDI has increased over time by noting that "there is some evidence that this sensitivity is increasing over time as globalization increases, especially in the form of international competition for highly mobile capital. However, other research suggests that the increase in the tax sensitivity of investment may be tempered by the increased availability of tax-avoidance devices that reduce the need to reallocate real investment in order to reduce tax liability in relatively high-tax countries." The question of whether the tax sensitivity of FDI has increased in recent years is discussed in more detail in Section 4.

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[25] In this literature, core regions have the location advantages noted above, while the periphery refers to smaller economies where output and input markets lack these characteristics.

[26] In this section, a higher or lower semi-elasticity refers to the absolute value of the semi-elasticity.

[27] Evidence of an increase in the tax sensitivity of FDI was found by Altshuler, Grubert and Newlon (2001) who examined the FDI in manufacturing by US multinationals in 1984 and 1992.

While meta analysis has its limitations—all observations from all studies are given equal weight in the regressions, even thought there may be obvious differences in the "quality" of research—it provides a useful perspective on the empirical literature. While there are clearly a wide range of estimates of the tax sensitivity of FDI, some of the factors that produce these variations have been identified. The overall conclusion regarding the empirical literature is also fairly robust—a higher host country tax rate reduces FDI.

3.2 Recent Empirical Studies of Taxation and FDI

Devereux (2007, p. 42) has noted that the "advent of microeconomic data is important in allowing researchers to study the decisions of multinational companies in more detail, and in giving them the opportunity to exploit, or control for, the many observed and unobserved differences across economic agents, and across countries." Many of the recent studies of taxation and FDI have utilized large microeconomic data sets on MNEs' activities in Europe, and we will now provide an overview of recent empirical studies of FDI and taxation.

Host Country Tax Rates and FDI

Bénassy-Quéré, Fontagné, and Lahrèche-Révil (2005) estimated a model based on FDI flows between 11 OECD countries over the period 1984-2000. The responsiveness of FDI (which excluded reinvested earnings) was estimated with respect to four measures of corporate income tax rates: statutory rates, average and marginal effective tax rates (METRs), and average rates based on corporate tax revenue and earnings data. In the baseline version of their model, all four versions of the tax variable were negative and statistically significant, with the average tax rate having the largest semi-elasticity of -9.40 and the METR having the smallest, -2.89. Countries with larger markets tend to attract more FDI, and they found that "a host country suffering from a 10% disadvantage in terms of market potential (compared to other host countries) can offset this handicap by a 5 percentage-point lower statutory tax rate." (p.588) Higher public investment in the host country was also associated with higher FDI. A higher distance-weight average tax rate for all other countries raised FDI in a given host country, consistent with the notion that differences in average tax rates affects the location of FDI.

They also explored non-linearities in the effects of tax rate differentials on FDI. They found that "a higher tax rate in the host country is more harmful to inward FDI than a lower tax rate is attractive for foreign capital" and that "increasing FDI inflows through tax cuts could prove more efficient in high-tax countries than in low-tax ones." (p.594) As expected, these non-linearities in the response of FDI to taxes occurred when home countries used a foreign tax credit regime; the responses were linear when countries used an exemption system.

Buettner and Ruf (2007) investigated the sensitivity of FDI to host country tax rates using a large micro data set from the Bundesbank on outbound FDI by German multinationals in 18 countries over the period 1996 to 2003. They found that the location of German MNEs' FDI is affected by the host country's statutory and average effective tax rates, but not by its marginal effective tax rate, a result which is consistent with Devereux's decision tree framework for FDI. Buettner and Ruf found that if a foreign country's tax rate increases by 10 percentage points, the probability that an investment occurs declines by 12.5 percentage points if previously there was a 50 percent chance that it would occur. They also found that the statutory tax rate has greater predictive power than the average effective tax rate which is somewhat inconsistent with Devereux's framework and previous empirical work in Devereux and Griffith (1998). Overall, they

found that the location of FDI by German MNEs is less tax sensitive than the Devereux and Griffith (1998) study of the location of FDI in Europe by US multinationals indicated.

While most studies have focussed on the host country's CIT rate, a study by Desai, Foley and Hines (DFH) (2004), based on using firm level data for 1982, 1989, and 1994, found that the host country's "indirect taxes" also affect the level of investment and production by US multinationals. These effects are quite large—a 10 percent higher host country indirect sales tax rate is associated with a 7.1 percent reduction in the affiliate's assets, an impact that is similar to an equivalent income tax rate increase. Their finding is especially significant when FDI is viewed from a global value chain perspective because FDI is linked to trade in intermediate goods. Devereux (2007, p.28) considers the findings somewhat puzzling as most OECD countries with value-added taxes (VAT) provide credits for the sales taxes that are levied on purchases of intermediate inputs and provide VAT rebates on products that are exported. However, not all countries levy value-added taxes. Retail sales taxes that fall on business inputs and excise taxes on motive fuels may raise the cost of doing business in countries with such taxes. The findings by DFH suggest that the recent adoption of harmonized sales taxes (which provide input tax credits) by Ontario and British Columbia might make Canada a more attractive location for FDI.

Home Country Tax Rates and FDI

While most of the empirical literature has focussed on the tax sensitivity of FDI to the host country's CIT rate, the home country's tax system will also affect the level of FDI. Barrios et al. (2008) focused on the effect of home country taxation on the location decisions of multinationals. In particular, they examined whether multinationals tend to have the parent firm located in a country with a relatively low rate of taxation of foreign-source income. Their study used the AMADEUS database containing data on multinational firms operating in 33 European countries over the years 1999 to 2003. Their sample consisted of 906 parent companies and 3,094 foreign subsidiaries. Parent corporations located in France, Spain, and the United Kingdom had the most foreign affiliates, while Denmark, Spain, and the United Kingdom were the host countries with the most foreign affiliates operating in them.

Barrios et al. computed the taxes levied by home and host countries on foreign affiliates' dividend payments to their parents. The mean value of the overall effective tax was 35.3 percent, consisting of a mean host country tax of 30.2 percent and a mean international tax of 5.1 percent. The international tax reflects the withholding taxes levied by host countries and any additional tax levied by the home country. They found that both home and host country tax rates reduced the likelihood of FDI in a particular country, and the magnitudes of these impacts were about the same, while the effect of withholding taxes was statistically insignificant. In addition, they found that taxes affect where a multi-national firm chooses to locate its parent corporation, with a low residual home country tax increasing the probability that a parent of a foreign subsidiary will be located in a particular country. Barrios et al. (2008, p.4) concluded that "corporate taxation of foreign-source income is important in shaping the organizational structure of multinational firms."

Becker and Riedel (2008) also focussed on the effects of home country taxation on FDI. They hypothesize that higher home country corporate taxation not only reduces domestic capital investment, but it also reduces investment in the foreign affiliates of its multinationals. They posited three reasons why this might occur. First, this effect could arise if the parent and foreign affiliates use common inputs (such as patents from R&D) and higher domestic taxes reduce the common input, reducing the ability of the firm to

compete in foreign markets. Second, if the MNE is credit constrained and has to finance investment out of retained earnings, higher home country taxes would reduce the ability of the MNE to invest both at home and abroad. Third, if the ability to use transfer pricing to shift profits is related to the size of the MNE's capital stock, higher home country taxes by reducing domestic investment would also reduce its ability to reduce foreign and domestic taxes and earn a higher rate of return on FDI.

Becker and Reidel (2008) also used the AMADEUS database where both the parent and subsidiary firms operate in 25 EU countries from 1995 to 2006. In their baseline regressions, the semi-elasticity of the foreign subsidiary's capital stock with respect to the host country statutory tax rate varied between -1.42 and -1.67, depending on the specification of the regression, while the semi-elasticity with respect to the home country statutory rate varied between -0.56 and -0.71. Thus a ten percentage point increase in the home country's CIT rate is associated with a 5.6 to 7.1 percent decrease in the affiliate's capital stock. The tax sensitivity of FDI to the home country tax rate was even higher for manufacturing firms and for parents with intangible assets such as patents and trademarks. They also found that a higher home country tax rate had no effect on the capital stocks of foreign affiliates of high profit parents, while there was a strong negative effect on the foreign subsidiaries of low profit parents. This result is in line with the hypothesis that higher taxes that reduce the retain earnings of parents reduces foreign investment of firms that face capital market constraints. Finally, they found evidence of profit-shifting, as affiliates' profits were negatively related to the tax rate differential between the host and home countries, with a semi-elasticity ranging from -0.71 to -0.84. Other research studies indicating tax motivated profit-shifting will be reviewed in Section 3.3.

Bilateral Tax Rates and FDI

Egger et al. (2007) focussed on the impact of bilateral tax rates, which reflect the provisions of the double taxation treaties signed between countries, on FDI. These treaties describe the method of double taxation relief (credit, exemption, or in rare cases deduction of foreign taxes) by the home country, and the withholding tax rates that the host country applies to dividend, interest payments, and royalties. The authors computed the bilateral tax rates between the home and host countries and also what they called the unilateral tax rates, which are the average and marginal effective tax rates that apply to domestic firms in the home and host country. They argued that all three types of tax rates will influence the level of FDI because, holding the bilateral tax rate constant, a higher home country tax rate makes producing the product abroad more attractive than exporting, and a higher unilateral country tax rate gives foreign investors an advantage compared to domestic firms in the host country's market.

They computed unilateral and bilateral tax rates between 22 home and 26 host countries (all OECD members). They found that the median bilateral average effective tax rate exceeded the rate for the host country's domestic firms by 6 percentage points, although they noted that this differential declined over the period. The higher tax rate faced by foreign investors compared to domestic investors was largely due to the withholding taxes that are levied by host countries on the repatriated earnings of foreign-owned firms.

Their finding that the foreign affiliates of multinational firms faced higher tax rates than domestic firms in the host country was based on the assumed method of financing the foreign affiliate. Their computations do not reflect the possibility that foreign investment may be financed through a conduit entity situated in a low tax country which could result in significant reductions in taxes on FDI through the double deductions of

interest payments on debt and the use of hybrid securities. See OECD (2007b), Dahlby (2008), and Chen and Mintz (2008) on how these financing schemes measures can reduce the average and marginal effective tax rates on FDI.

They estimated their model on 2,361 observations on aggregate bilateral FDI stocks between 1991 and 2002, and found, as they predicted, that higher home and host country unilateral tax rates were associated with higher levels of FDI, while a higher bilateral tax rate reduced FDI.[28] They argued that previous research that did not take into account both unilateral and bilateral tax rates likely produced downward biased estimates of the effects of taxes on FDI.

Egger et al. (2009) extended these authors' previous research on taxation and FDI by expanding their sample to include 52 home and 45 host countries over the period 1991 to 2004. They estimated a model with home and host country statutory tax rates and depreciation allowances for tax purposes and the withholding tax rate applied by the host country as explanatory variables. For the sample of home countries that use the exemption system, they found that a higher host country statutory CIT rate or a higher withholding tax rate on repatriated profits reduced FDI, in line with expectations. However, a higher home country statutory CIT rate reduced FDI, contrary to expectations and the results in their previous study which had indicated that a higher home average effective tax rate increases FDI. In addition, they found that higher home and host country depreciation allowances reduced FDI, with the latter result inconsistent with the prediction that higher depreciation allowances in the host country, by lowering the average and marginal effective tax rates on investment, would increase FDI. However, a higher depreciation allowance in the host country benefits domestic firms as well as foreign affiliates, and it is possible that the net effect is to reduce the competitiveness of foreign firms and the volume of FDI.

One conclusion that they reached is that "different combinations of corporate profit tax instruments may lead to an identical level or change of the effective tax rate for the average MNE, yet the resulting impact on FDI or other modes of MNE activity may differ due to heterogeneous indirect effects on other firms." (p.34) As a result, they argued that it may be better to focus on instrument-specific parameter estimates, such as the effect of depreciation allowances on FDI, rather than ones based on aggregate effective tax rates.

Tax Sensitivity of Different Types of Investment

Stöwhase (2005) examined FDI outflows from Germany, the Netherlands, and the UK to eight other EU countries in 1995, 1996, 1998, and 1999 in the primary, secondary and tertiary sectors. The primary sector, which consisted on agriculture, fishing, mining and quarrying, had only one tenth of the FDI flows in the secondary sector (manufacturing) and the tertiary sector (transportation, communications and financial intermediation). He found that the average effective tax rate was not a statistically significant determinant of FDI in the primary sector and that FDI in the tertiary sector was much more sensitive to the differential between the host and home countries' average effective tax rates than the secondary sector.

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[28] The other independent variables in the regression as in most of the regression models estimated in this literature reflect the size of the home and host country markets and the distance between the home and host country.

Karkinsky and Riedel (2009) investigated the tax sensitivity of the location of MNEs' patent applications using data from the European Patent Office and the AMADEUS database on MNEs from 18 European countries from 1995 to 2003. The data set consists of 85,330 observations on patent applications by 11,828 subsidiaries of multinational enterprises. Their data show that the Netherlands and Switzerland have a large number of subsidiaries holding patent applications because these countries offer favourable tax treatment of royalty income.[29] They computed tax rates on royalty income by a subsidiary located in each country based on its statutory CIT rate and a simple average of the withholding tax rates applied by the other countries where its affiliates are located. The average withholding tax rate was only 1.1 percent (although it ranged as high as 30 percent) so that in most cases the most important tax consideration in the location of the patent application from a tax perspective is the CIT rate on the subsidiary's profits. Their econometric results indicate that a subsidiary's corporate tax rate, and its tax rate differential with other firms in the corporate group, have a negative effect on the number of patent applications that it makes, with a semi-elasticity of the volume of patent applications with respect to the tax rate of -2.3.

MacDonald (2009) also investigated the impact of taxes on the location of patenting activity by multinational enterprises. Her database was obtained from the US Patent and Trademark Office and contained firm-level information on the patenting activity of US multinationals in 20 OECD countries from 1986 to 2000. These data indicate that US multinationals engaged in substantial R&D investment in the foreign affiliates--$18 US billion in 1999--and the royalty payments by foreign affiliates to their US parents for the use of technology was also large--$25 US billion in 1999. The data also indicate that the foreign patenting activities of US multinational was concentrated in five of the 20 countries in her study—18.1 percent in Great Britain, 13 percent in Germany, 12.3 percent in Canada, 12.3 percent in Japan, and 10.3 percent in France.

She developed a theoretical model of an MNE which maximizes its total after-tax profits through its allocation of R&D activities in the US or in a foreign subsidiary. Her model predicts that an MNE with excess foreign tax credits (i.e. firms which face a higher average foreign tax rate than their US rate) will reduce its R&D investments in its foreign subsidiaries when the foreign tax rate increases. In contrast, an MNE in a deficit foreign tax credit position will not alter its foreign R&D investments when the foreign tax rate increases because the effective tax rate on its income is the US rate. (Note however this ignores the potential for reducing the present value of the residual tax through deferral.) Her model also predicts that MNEs should increase their R&D activities in foreign subsidiaries if the tax incentives for R&D become more generous in the foreign country.

She found, in line with her prediction, that firms in an excess credit position decreased the level of foreign patenting activity when the firm's average foreign tax rate increased. However, country specific statutory tax rates were not significantly related to the degree of foreign patenting activity by US multinationals. Foreign patenting activity also increased with the foreign tax incentives for R&D. Contrary to expectations, she also found that foreign patenting activity increased as foreign tax rates increase for US MNEs in a deficit credit position.

[29] See also Weichenrieder and Mintz (2007) on the tax treatment of holding companies in the Netherlands and Switzerland.

3.3 Empirical Studies of Taxation and Profit-Shifting

Tax Base Shifting Through Transfer Pricing and Debt Placement

A number of previous studies, such as Bernard and Weiner (1990), Grubert and Mutti (1991), Harris et al. (1993), Hines and Rice (1994), Collins et al. (1998), Hoffman (2001), Bernard et al. (2006) and Overesch (2006) have provided evidence of profit-shifting by multinationals through transfer pricing.[30] Some of the strongest direct evidence is contained in Clausing (2003). She used monthly data from the US Bureau of Labor Statistics on the prices of exported and import goods into the United States for three years, 1997 to 1999, from 54 countries. The data set allowed her to distinguish between intrafirm and non-intrafirm prices on 22,000 items. Her regression analysis indicates that a one percent reduction in a host country statutory tax rate results in 1.8 percent lower prices on exports from the US and 2.0 percent higher prices for imports to the US on intrafirm trade compared to non-intrafirm traded goods.

Huizinga and Laeven (2008) developed a theoretical model of profit-shifting by an MNE which predicts that the amount of taxable income shifted into country j is:[31]

- proportional to the "true" level of profits earned in country j because it is less costly to conceal additional profits in a highly profitable subsidiary,
- decreasing in the statutory tax rate of country j,
- decreasing in the marginal cost of shifting profits through transfer pricing and debt placement, and
- directly related to a weighted average of the differentials between the other countries' statutory tax rates and country j's statutory tax rate, where the weights are increasing in the other countries' true taxable incomes.

Their model thus predicts that the tax sensitivity of a country's corporate tax base depends on its tax rates relative to the tax rates in all other European countries in which its MNEs operate, and it also depends on the level of investment in that country compared to other countries.

They then used the AMADEUS database to examine the degree of corporate tax base shifting in Europe in response to tax rate differentials. Overall, they found that a one percentage point increase a country's top statutory CIT rate reduced the reported taxable income of its MNE-linked firms by an average of 1.3 percent. However, there were substantial variations in the tax sensitivity of the tax bases, with the semi-elasticity of the tax base with respect to the country's CIT rate ranging from -0.28 for Germany to -2.92 for the Netherlands. The cost of profit-shifting was estimated to be 0.6 percent of the tax base.

Huizinga and Laeven's analysis indicated in 1999 there was substantial profit shifting in Europe at Germany's expense because it had the highest tax rate, at 53.76 percent, compared to the European average of 34.44. Approximately 13.6 percent of its "true"

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[30] For many intra-firm transactions, there may be no well-defined arm's length prices because the inputs transacted are unique to the firm. This can give the firm considerable leeway in setting its transfer prices. Lowering its total tax liability may be one of the factors that it considers in setting those prices. Profit-shifting can also occur through the location of debt financing. See Dahlby (2008) for a survey of the empirical literature on profit-shifting by MNEs through the location and magnitude of debt used to finance FDI and Clausing (2009) for the estimates of tax motivated profit-shifting by U.S. multinationals.

[31] This section on the Huizinga and Laeven model draws on the literature survey in Dahlby (2008).

taxable income was shifted from Germany. Italy, Portugal and the Slovak Republic also suffered outward profit-shifting. Hungary and the Czech Republic had profits shifted to them equal to 22.4 and 26.3 percent of their true profits respectively. While Hungary, with a tax rate of 18 percent in 1999, was an obvious target for tax base shifting, the high degree of shifting to the Czech Republic indicates that a country can benefit from tax base shifting, even if its tax rates are close to the average, if the firms operating in its territories are linked with firms in higher taxed countries (such as German), and if large "real" profits are generated from extensive business linkages with the high tax countries.[32]

Maffini and Mokkas (2008) investigated whether transfer prices used by MNEs for inter-affiliate trade have affected the measured productivity of the affiliates. In particular, they tried to determine whether the productivity of affiliates in low tax countries is overstated because the MNEs have an incentive to overstate the value of the goods they produce and understate the value of the inputs they use through intra-group transactions.[33] Base on the ORBIS database of approximately 16,000 firms in 10 European between 1998 and 2004, they found that a 10 percentage point cut in the statutory CIT rate corporate tax rate increases an affiliate's measured total factor productivity by about 10 percent relative to domestic firms. Conversely input costs are shifted to high tax countries. They interpreted this as evidence of profit-shifting by MNEs through transfer price manipulation.

Dischinger and Riedel (2009) found evidence that MNEs systematically shift profits from foreign subsidiaries to the parent company. Using the AMADEUS database on firms from 27 European countries over the period 1999-2006, they found that the return on investment is on average 30 percent higher at headquarters than in the foreign subsidiaries. They argued this profit gap occurs in order to overcome agency costs that arise when the managers of foreign affiliates are geographically separated from headquarters management and might have the ability to "misuse" any free cash flow. They also found that over the last decade, as communications and travel costs have declined, the profitability gap between the parents and foreign subsidiaries has declined for vertical FDI but not for horizontal FDI.[34] Tax motivated profit-shifting was significant for vertical FDI, but not for horizontal FDI. Because parent corporations paid 61% higher taxes on their corporate activity than their subsidiaries, Dischinger and Riedel concluded that profit-shifting to control agency problems provides a rationale for governments to promote multinational firms headquartered in their country—create national champions—rather than try to attract foreign subsidiaries.

Grubert (2009) used data from US Treasury tax files to compare the foreign and domestic profits of 754 large non-financial US multinationals in 1996 and 2004. He found that the share of total world-wide pre-tax profits earned abroad increased from 37.1 percent in 1996 to 51.1 percent in 2004. During this period, foreign tax rates generally declined relative to US tax rates, creating greater incentives for US based multinationals to shift income abroad. He also noted that shifting income within a US multinational has

[32] Overesch (2009) found that FDI in Germany is increasing in the difference between the German statutory tax rate and that of the home country of the subsidiary's direct owner. Thus, a reduction in the home country tax rate increases outbound FDI, an effect that he attributed to a reduction in the MNE's cost of capital due to profit-shifting.

[33] See Bartelsmann and Betelsmann (2003) for earlier previous study of the effect of transfer pricing on measured productivity especially with respect to in Ireland.

[34] An MNE may also want to shift profits out of a subsidiary in a politically unstable foreign country, especially if there is a danger that the subsidiary might be expropriated by the foreign government.

became easier with "check the box" provisions in the US tax code which allows interest payments from a foreign subsidiary to escape US taxes because it is considered part of the consolidated domestic company.

Grubert found that 6 of the 14 percentage point increase in the share of foreign profits in total world-wide profits can be attributed to increases in losses sustained by US parents. Lower foreign tax rates over the 1996 to 2004 period lead to faster growth in the foreign activities of US multinationals and increases in the share of profits in earned abroad. He found that lower foreign tax rates are associated with higher US domestic losses, and he attributed 0.5 to 2.0 percentage points of the 6 percent shift due to higher losses by parent firms to foreign tax rate reductions. He also found that a 10 percentage point lower foreign tax rate lowers the US parent's domestic profit margin by 14 percent and increases the foreign share of worldwide income by more than 4 percentage points. Overall, of the 14 percentage point increase in the share of foreign profits, he attributed 5.5 to 8.0 percentage points to reductions in foreign tax rates.

The Quality and Quantity of FDI

Tax motivated profit-shifting also figured prominently in Becker, Fuest, and Riedel (2009). They set out to measure the quantitative and qualitative effects of higher host country tax rates, where quantity is the size of the affiliate's capital stock and quality is the rate of return on capital earned by the affiliate. Essentially, high quality capital contributes more to a country's tax base than does low quality capital. They argued that in the standard model of tax competition, a country with a higher tax rate will have a higher quality of capital, because the pre-tax return on the marginal unit of capital has to be higher in order to earn the same after-tax return as capital in lower tax jurisdictions. However, they used the framework of the GRH task trading model to argue that a country with a lower tax rate will attract those tasks where the corporate tax base per unit of capital is higher. In their model, a lower host country CIT rate should be associated with a higher physical capital stock and a higher profit rate per unit of capital because firms shift high profit tasks to low tax countries to maximize total after-tax profits. The Becker, Fuest, and Riedel paper is therefore notable in being the first econometric study to use the task trading framework to generate predictions about the effects of taxes on FDI.

Becker, Fuest, and Riedel also used the AMADEUS database for 29 European countries, containing 49,236 observations from 11,813 subsidiaries for the years 1995 to 2005. They found that a one percentage point increase in the host country's statutory CIT rate reduces the affiliate's capital stock by 3.36 and the profit-rate earned by the affiliate by 2.08 percent. Thus a one percentage point increase in the CIT rate reduces the host country's corporate tax base by 5.34 percent. They argued that because of the quantity and quality effects of taxes on a government's tax base are almost the same, attention should be paid not only to the volume of FDI, but also the corporate tax revenues that it will generate.

The Use of Holding Companies and Conduit Entities

Weichenrieder and Mintz (2007) have studied how the ownership structure of FDI may be influenced by international tax considerations. They worked with a special database established by the Bundesbank for the years 1989 to 2002 on the use of holding companies and conduit entities for German inbound and outbound FDI. They noted that some countries have established special tax regimes that make the establishment of holding companies of multinationals especially attractive. The Netherlands, from 1997 to 2010, reduced the rate of tax on interest income from foreign subsidiaries from 35 percent

to 7 percent, and holding companies in Switzerland only face an 8 percent tax rate. Not surprisingly, these countries are popular locations for holding companies with investments in third countries.

The Bundesbank data reveal that in 2001, 11 percent of German affiliates, representing 6 percent of total outbound FDI, were held through third countries, whereas 25 percent of the inbound FDI (13 percent by value of assets) was held through entities in third countries. Weichenrieder and Mintz found that the Netherlands and Switzerland are the two most frequently used conduit countries for German outbound FDI, followed by the Austria, US, the UK, and France. They also found that tax havens, such as Bermuda, Barbados, the Cayman Islands, and the Bahamas, were not widely used as conduit countries for German outbound FDI in 2001 because Germany did not have tax treaties with them. (Tax treaties reduce the tax on dividend income from foreign subsidiaries located in the treaty countries.) They noted that subsequent changes in German tax treatment of dividends, which extends exemption treatment to non-treaty countries, may have made the establishment of conduit entities in these tax havens more attractive. Luxembourg was the most important conduit country for inbound German FDI, with most of this investment ultimately owned by UK firms.

Of the 105 German investments in Canada that were owned through conduit entities in third countries, 68 were located in the US, 12 were located in both the Netherlands and Switzerland, 8 were located in the UK, and 5 were located in France. By value of assets, 94 percent were owned through entities located in the United States and 5 percent through entities locate in the Netherlands.[35] Of the 13 Canadian firms with investments in Germany held through entities in third countries, 9 were located in the Netherland and 4 were located in the UK. The Netherland-based entities held 91 percent of these assets.

4.0 Summary and Implications

Key Aspects of the Trading in Tasks Framework

Recently, trade economists have developed models which analyze some of the forces shaping the global value chain, but these models have ignored the role that taxation may be playing. On the other hand, public finance economists have generally ignored the trade economists' models in formulating and interpreting their empirical models of the effects of taxes on FDI. This chapter has taken up the challenge of linking the two fields—a linkage that cannot be fully achieved at this time because of the divergent approaches and interests of economists in the two fields. However, in our view, linking the two fields is a potentially fruitful research program because intra-firm trade is an important aspect of world trade and is intimately connected with FDI. Public finance economists need the richer framework offered by the trading in tasks framework in order to capture key aspects of FDI decisions.

One of the main goals of this paper was to include taxes in a modified version of the trade in tasks framework developed by Grossman and Rossi-Hansberg (2008), which has been singled out by trade economists as a major advance in understanding the implications of international trade in intermediate inputs. In this modified GRH model, the effect of host and home country corporate income taxes on FDI can be decomposed into a *shore* and a *scale* effect. The shore effect refers to changes in FDI due to changes in the range of tasks undertaken in the affiliate or the parent, while the scale effect refers to changes in FDI due to changes in the volume of production caused by changes in the cost of the

[35] Weichenrieder and Mintz (2007, Tables 5 and 6, pages 14 and 15).

labour and capital in both countries. The model indicates that corporate income tax rates in both the host and home countries will affect the level of FDI and intra-firm trade in intermediate inputs in complex ways. Our analysis indicates CIT rate increases often have ambiguous, or offsetting, shore and scale effects on FDI.

The GRH task trading model, by making the range of tasks that can be performed in the affiliate or the parent an important economic decision highlights the important role that transfer prices play in determining the responsiveness of FDI. The model indicates that tax rate differentials between host and home countries can influence the allocation of tasks between the parent and foreign affiliates through their effects on the after-tax costs of labour and capital in the home and host countries and through the transfer prices that are used to value the tasks that are performed by each unit.

A few special insights from the modified GRH model should be highlighted.

First, the modified GRH model may be useful in determining the conditions under which tariff reductions on final products and intermediate inputs either promote or inhibit FDI. That is, it may help us to understand under what conditions FDI and trade are complements or substitutes.

Second, the GRH model indicates that an increase in the home country tax rate under certain conditions may inhibit FDI because of adverse shore or scale effects. This prediction is at variance with the conventional tax competition model which predicts that capital will flow out of the home country in response to a CIT rate increase. It is interesting to note that several of the recent empirical studies, which are referred to in more detail below, have found that higher CIT rates are associate with lower outbound FDI.

Third, the modified GRH model indicates that the division of tasks between any two foreign affiliates operating in different countries depends on all of the tax rates imposed in the countries in which the MNE has operations, something that is not highlighted in conventional models of the effects of taxation on FDI This of course poses special challenges for estimating econometric models of FDI if the volume of investment in any host country depends not only on the home and host country tax rates, but also on tax rates in third countries where the MNE has affiliates that are part of its global value chain.

Fourth, foreign affiliates can have a lower after-tax cost of capital than a purely domestic firm through financial arrangements such as the use of hybrid securities or ownership structures that lead to "double dip" interest deductions. The model therefore predicts that foreign affiliates will tend to perform capital intensive tasks, while outsourcing offshore labour intensive tasks, in the same foreign country. It also suggests that when the home country's tax rate declines, we might expect to see an increase in the capital intensity of the intermediate inputs that are outsourced offshore because the cost of capital advantage of the foreign affiliate may decline when the home country's tax rate declines. It also implies that in any country, foreign-owned firms should be more capital intensive than purely domestic firms, and this difference in capital intensity should be increasing in the home country's tax rate.

Fifth, a reduction in the home country's CIT rate is predicted to increase offshore outsourcing compared to production by the MNE's foreign affiliates operating in the same country. One testable prediction of the model is that the ratio of outbound FDI to imports of intermediate inputs from any foreign country should decline as the home country's CIT rate decreases.

Finally, compared to the conventional model of taxation and FDI, the trading in tasks framework suggests that FDI can be very sensitive to the host country tax rate because

FDI is affected by the range of tasks that are performed by the foreign subsidiaries of MNEs.

While it is too early to claim that the trading in tasks framework provides a better framework than the conventional model for analyzing the effects of taxes on FDI, the fact remains that several recent empirical studies have found that FDI declines when home country tax rates increase, a result that is at variance with the predictions of the conventional model, and some empirical studies indicate that FDI may occur to facilitate profit-shifting through transfer pricing, an aspect MNE behaviour that is highlighted in the trading in tasks framework .

Summary of the Empirical Studies of Taxation and FDI

An important implication of Devereux's decision tree framework is that the average effective tax rates, the marginal effective tax rates, and the statutory tax rates of both the home and host affect the location and volume of FDI. Thus, empirical studies need to use a variety of tax rate measures for the home and host countries in order to capture the full impact of taxation on FDI decisions. While all three measures of CIT rates have been used in studies, average and marginal effective tax rates have yielded larger semi-elasticities with respect to FDI than statutory tax rates. Also recent research suggests that more disaggregated or refined measures of tax rates, such as depreciation allowances or bilateral tax rates including withholding tax rates, may improve the predictive powers of the econometric models. Furthermore, there may be non-linearities in the response of FDI to tax rates. Higher CIT rates may cause a greater reduction in FDI than the increase in FDI from an equivalent CIT rate reduction, and there may be decreasing return to increasing FDI through CIT rate cuts. There are also some indications that other taxes beside the CIT rates are important in determining the level of FDI. The results obtained by Foley, Desai and Hines (2004), which indicated that indirect taxes affect the level of FDI, are intriguing and warrant further study.

While most of the empirical literature has focussed on the effects of host country tax rates on inbound FDI, several recent empirical studies have found that higher home country CIT rates are associated with lower outbound FDI. Barrios et al. (2008) found that parents of MNE tend to be located in low tax countries. In that sense, higher home country rates are associated with lower FDI, not higher FDI as in the conventional model. Egger et al. (2009) and Becker and Reidel (2008) also found that higher home country CIT rate reduced outbound FDI with some indication in the latter study that reduced retained earnings, a source of financing for FDI, may be responsible for the negative effect.

The recent literature also indicates that some types of FDI are more tax sensitive than others. Investment in the primary sector seems to be relatively insensitive, whereas investment is the tertiary sector (services) is more tax sensitive. In particular, the studies indicate that the location of patents (which may reflect to some degree the location of R&D activity by multinationals) responds to CIT rate differentials and tax incentives for R&D. These results are consistent with the growing body of evidence that tax differentials lead to profit-shifting by multinationals through transfer pricing, financial arrangements, and their organizational structures.

Implications of Global Value Chains for Tax Policy

The growing importance of international trade in intermediate inputs has provoked heated debates, especially in the United States, over its impact on labour markets.[36] Trade

[36] See Mankiw and Swagel (2006) and Blinder (2009).

economists have been at the forefront of this debate, and they have focussed on the labour market policy issues arising from the expansion of global value chains. In this section, we will review the broad policy issues identified by two prominent trade economists—Dan Trefler and Robert Baldwin—but our focus will be on the implications for tax policy, an issue which have not received much attention from trade economists.

Trefler (2006) presents a wide ranging survey of the potential impacts of offshoring for the Canadian economy. Although the growth of trade in intermediate inputs is a relatively new phenomenon, Trefler (2006, p.5) has argued that:

Offshoring creates only a few new policy issues. First, it forces Canadian firms to be part of a global market and hence to compete globally. It thus makes framework policies that encourage investment and competitiveness all the more important. Second, it creates more churning among firms and workers, thus destroying human capital that is specific to worker-firm matches. We must think of policies that encourage these investments without at the same time creating the kinds of labour market inflexibilities that are the source of Euro-sclerosis. Third, it is important politically to find ways of helping workers displaced by service offshoring.

Trefler's main point is that offshoring creates greater pressure for countries, such as Canada, to become more globally competitive through investment in human capital, physical capital, and new technology. Dealing with the pressures to promote international competitiveness has been the one of the factors shaping tax policy in Canada and other OECD countries for the last 10 to 20 years. (Of course, promoting investment and employment in purely domestic activities has also been an important motivation for reducing CIT rates.) Marginal effective tax rates have been reduced to promote investment, and statutory CIT rates have been lowered to reduce profit-shifting. Promoting investment in human capital involves both personal and corporate tax policy. The personal income tax treatment of tuition fees and other expenses associated with general education, and the progressivity of the personal income tax system, will affect individuals' incentives to acquire training and education. The corporate tax system affects the after-tax cost of employer-provided on-the-job training. Promoting innovation through generous tax treatment of R&D investment has been a constant aim of Canadian corporate tax policy. Whether more could, or should, be done through the Canadian tax system to promote R&D (which is already very generous by international standards) is a controversial topic. With increasing emphasis on global value chains, new technology developed in Canada may simply be transferred abroad to be used by foreign affiliates or third parties, raising further questions about the effectiveness of generous R&D tax credits in promoting the well-being of Canadians generally.

Robert Baldwin (2006, 2009) has argued that the fragmentation of the global value chain has important features which will shape policy responses. In his view, future changes in competitiveness will be sudden and unpredictable and felt primarily at the level of the individual worker as opposed to having firm-wide, or sector-wide, effects. Sudden and unpredictable changes in competitiveness will arise because it is difficult to forecast the types of activities where the costs of coordination, transportation, and communication will decline because of technological innovations. These changes will affect individual workers or occupational groups. Otherwise identical workers (in terms of education or skills) in the same firm or industry may either find their productivity enhanced, because they are able to work with lower cost complementary inputs, or their wage rates and employment opportunities undermined, because of outsourcing. In other words, it will become increasingly difficult to predict "winners and losers", and these groups will be subsets of

workers in the same firms and industries. There will be no sunset or sunrise industries, only sunset or sunrise occupations or skill sets that apply across a range of sectors.

If Baldwin is correct, the implication for corporate tax policy is that governments should continue to aim to achieve a low statutory rate on a broad base. Governments should refrain from setting lower rates in certain sectors, such as manufacturing, because of the competitive pressures from offshoring, or trying to promote certain sector through tax incentives, because the pressures and the opportunities will occur at a finer division than at the industry level. In any event, the unpredictable nature of future technological changes, which Baldwin stresses, makes picking winner or protecting losers an even more dubious strategy than it has been in the past.

Perhaps the most important issue for tax policy arising out of the increasing international fragmentation of production is whether FDI is becoming more sensitive to corporate income tax rate differentials, and therefore putting even greater pressure on countries to lower their corporate income tax rates. At one level, the fragmentation of production likely makes investment more tax sensitive because at the margin the decision is now where to place a particular task, instead of where to locate a particular plant. The greater range of options for locating tasks, as opposed to plants that are large lumpy investments, would tend to make FDI more sensitive variations in average and marginal effective tax rates across countries. Also, the tax sensitivity of FDI will have increased if technological innovations have now reduced the cost of offshoring capital intensive and highly skilled tasks, whereas previously coordination cost reductions mainly allowed offshoring of labour intensive tasks. (Recall that Tables 4 and 5 show that FDI is more tax sensitive when the firm's activities are more capital intensive.) However, the increased use of sophisticated international financing arrangements and transfer pricing, which allows firms to shift taxable profits across international boundaries, may be an offsetting force that may make FDI less responsive to tax rate differentials across country. For example, Hong and Smart (2007, p. 17) have developed a model of international investment which indicates that while "income shifting to tax havens may reduce revenues of high-tax jurisdictions and increase tax base elasticities, it tends to make the location of real investment *less* responsive to tax rate differentials." [Emphasis in the original.]

Given that there are a number of potentially offsetting factors which may be influencing the tax sensitivity of FDI over time, this issue can really only be resolved by econometric studies. The strongest evidence for an increase in the tax sensitivity of FDI is a study by Altshuler, Grubert, and Newlon (2001) who found that the semi-elasticity of US outbound FDI in manufacturing increased from -1.5 in 1984 to -2.8 in 1992. Also, as previously noted, in their meta analysis of studies of the tax sensitivity of FDI, de Mooij and Ederveen (2006) found that studies that used more recent data produced larger semi-elasticities. (However, the differences were not statistically significant.) Given this slender body of evidence, it would be rash to draw a general conclusion, and we have to await further empirical research, which specifically addresses this issue, before making any strong claims about the effects of international fragmentation of production on the tax sensitivity of foreign direct investment.

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Supply Chain Finance: A New Means to Support the Competitiveness and Resilience of Global Value Chains

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Introduction

The emergence of integrative trade and global value chains (GVCs) over the past 20 years has changed the competitive landscape in international goods and services markets.[1] Competition in many lines of businesses, particularly in the manufacturing sector, is now taking place more at a value chain level than at a company level. This development has increased the focus of large corporations on the efficiency with which goods, information and money flow within GVCs. Factors that characterize GVCs, such as geographic dispersion and a high number of participants, make it challenging to manage these three types of flows in a coordinated fashion. Yet, if a GVC is to become or remain competitive, it is important to continuously seek opportunities to optimize all of these flows.

GVC participants have placed a lot of emphasis over the past decade on improving the "physical supply chain", that is the way goods are designed, procured, held in inventory and delivered. They have worked hard with their logistics partners to reduce costs, accelerate delivery times, better manage risk and automate information flows. As a result, the management of materials and final goods takes place very efficiently today, allowing GVC companies (and in particular large GVC buyers that occupy a central position within GVCs - which we will refer to in this paper as "GVC anchors") to procure with relative ease from suppliers located in multiple and distant markets.

Progress has been slower to occur, however, in connection with the "financial supply chain" – that is the flows of financial information and money that take place between GVC members. Many GVCs that have smoothly-operating physical supply chains display inefficient financial supply chains that have a tendency to shift the burden associated with the financing of short-term assets (such as accounts receivable and inventory) down the supply chain to smaller suppliers. Greater attention has thus been paid in recent years on improving financial flows within GVCs. The financial crisis, which made retaining cash and managing the risk of supplier and distributor failure key priorities, provided a strong

[1] Integrative trade refers to the broad business structure adopted by many Canadian and foreign companies. It expands the traditional trade model, that centers on the exporting and importing of goods, to include cross-border investment, the integration of imports into exports, trade in services and sales from foreign affiliates established through foreign investment. The formation and operation of global value chains are a core element of integrative trade.

incentive to the chief financial officers (CFOs) of GVC anchors to improve the effectiveness of their financial supply chains. Following the crisis, efforts continued to be deployed by firms in Canada, the United States and elsewhere in order to improve the operation of their financial supply chains.[2]

The aim of this paper is to introduce the reader to the financial supply chain and to the strategies that can be used to improve its efficiency through the use of supply chain financing solutions. The latter represent a specialized set of technology-driven financial services that GVC anchors and suppliers in major world markets have been adopting at a steady pace over the past five years. In Canada, large companies that act as GVC anchors have also started using supply chain financing solutions, although adoption is taking place at a slower pace. The offer for supply chain financing solutions in Canada is characterized by a number of constraints that limit their availability for Canadian GVC anchors, exporters, suppliers and sub-suppliers. Since these solutions can help safeguard the competitive position of Canadian segments of GVCs and, at the same time, represent a potential means to alleviate some of the credit market gaps presently observed in Canada, a public policy response may be in order to help increase the availability of supply chain finance in Canada.

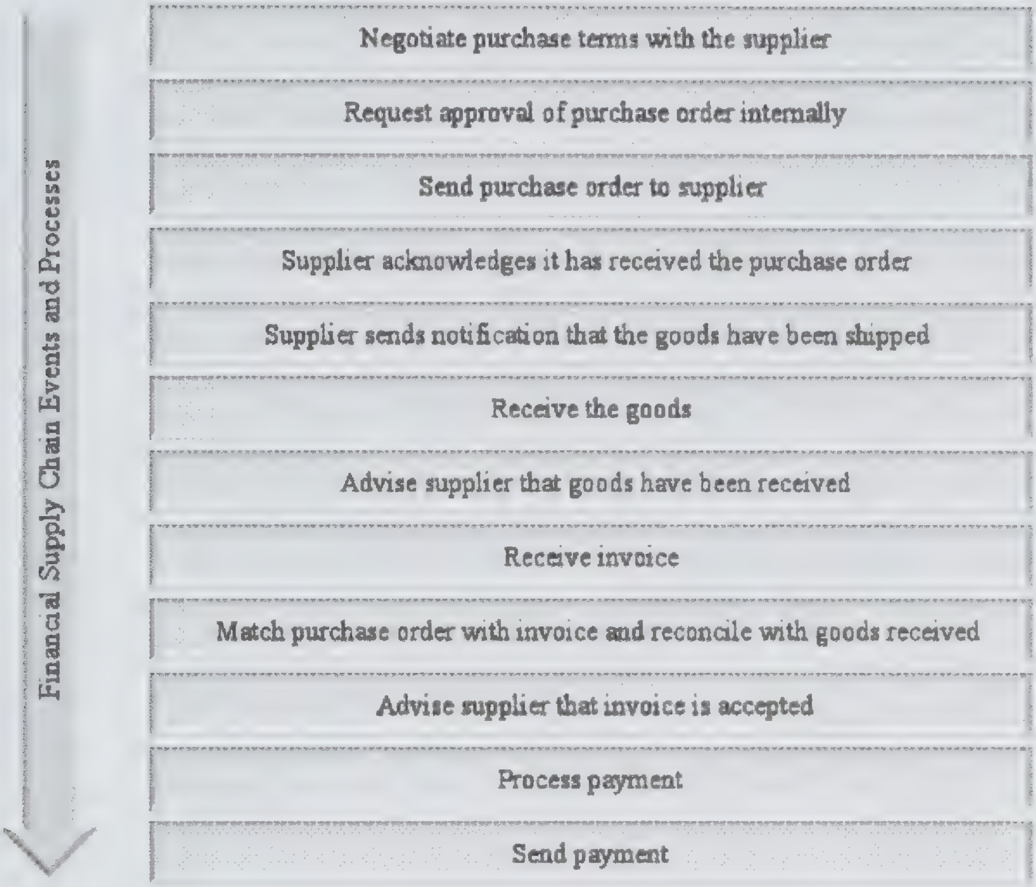
This paper includes six sections. The first one describes the financial supply chain and its current shortcomings. The second one introduces the reader to the most common supply chain financing solutions and the benefits they bring. Sections three and four discuss, respectively, the current state and the outlook for supply chain finance globally. The Canadian supply chain finance landscape is presented in section five while the last section examines whether some of the currently observed credit market gaps in Canada could potentially be addressed through the use of supply chain financing solutions.

The Financial Supply Chain

The financial supply chain is comprised of the sequence of financial events and processes that take place as commercial transactions are executed. These events and processes include flows of financial information (e.g. sending a customer an invoice) and money between GVC members. The major financial supply chain events and processes that occur when a company *purchases* goods from another value chain participant are depicted below (Figure 1).

[2] For example, in a survey of 1,500 European corporates conducted in May 2010, close to 60% of respondents indicated that finding ways to increase supplier access to financing would remain a priority even once the economic recovery gained momentum. See Demica, "Securing Growth, Supply Chain Finance – A Fourth Report from Demica", June 2010, p. 7.

Figure 1. Financial Supply Chain Events and Processes (Buyer's Perspective)



Source: Prepared by the authors

From the perspective of a company that *sells* goods to another value chain member, key financial supply chain events and processes mirror the ones presented above (e.g. in the third step, the purchase order is received as opposed to sent). Although seemingly simplistic, Figure 1 depicts supply chain events and processes in respect of which financial flows are regularly inefficient within domestic, regional and global value chains.

Typical domestic and regional financial supply chain inefficiencies

Business-to-business invoicing is slow and costly in North America due to lack of automation. In the United States, 70 per cent of companies still issue paper invoices to their clients and it takes 55 days, on average, to manually process these and other printed commercial documents.[3] As a result, processing costs can reach 50 or more US dollars *per invoice* compared to 50 US cents for companies that fully leverage automated invoicing systems.

Another example is the limited use of electronic payment systems by North American companies. It is estimated that 75 per cent of non-cash business-to-business payments in the United States are still made using cheques.[4] In comparison, cheques are expected to

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[3] Steve Berez and Arpan Sheth (2007), "Break the Paper Jam in B2B Payments" *Harvard Business Review*, November 2007, p. 28 and Ian Bryant and Richard Bottomley, "Financial Supply Chain Management - Part 2: Dematerialization and Automation", *GTNews*, May 3, 2007.

[4] Source: Forte Consulting Group, as referenced in "Market Insight: Why B2B payments need a 'BizPal'", First Data Corporation, 2009, p.1.

soon disappear from the business-to-business payment landscape in Northern Europe while their use is falling across the rest of Europe.[5] Cheques remain widely used by companies in Canada and the United States to settle accounts payable as they represent a simple way to hang on to cash longer ("the cheque is in the mail…"). There are indirect costs associated with this method of retaining cash since electronic payments are less expensive, reduce fraud and facilitate the transition to electronic invoicing (another source of savings). The end result for Canadian and American companies is that, although payment terms are regularly set at 30 days, they typically get paid in 45 to 60 days - the same time it took forty years ago.[6]

Typical global financial supply chain inefficiencies

Compared to domestic and regional supply chains, GVCs involve a larger number of companies and countries and span greater distances. They also give rise to more documentation: for a typical GVC transaction, as many as 40 documents can come into play that emanate from up to 20 different companies.[7] Banking practices, as well as the use and sophistication of information technology also vary more within GVCs than within domestic and regional value chains. All of these elements make it challenging to accelerate the speed at which financial supply chain events and processes take place. In turn, this lengthens the time it takes for suppliers to get paid - especially if they are far removed from the GVC anchor along the value chain.

Another phenomenon that frequently weakens the effectiveness of financial supply chains is the tendency of GVC anchors to improve their cash position at the expense of *upstream* or *downstream* GVC participants.[8] Prior to the financial crisis, CFOs of GVC anchors had been under intense pressure to cut financing costs and to free up cash through better management of accounts receivable, inventory and accounts payable. The crisis made attaining these goals an even greater priority as credit markets dried up and sales and profits fell. Over the past few years, GVC anchors have thus been extracting even greater amounts of cash from their accounts receivables (by pressuring buyers to pay more quickly), accounts payables (by paying suppliers later) and inventory (by ordering as little and accepting delivery as late as possible).

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[5] The use of e-payments between businesses is prevalent in the Scandinavian countries and should also become widespread in a few more years across Europe when the Single Euro Payments Area (SEPA) is fully implemented. Since January 2008, SEPA allows businesses to receive and send euro payments using electronic credit transfers anywhere across the SEPA area within a predictable timeframe and at the same cost, irrespective of destination. Thirty-two countries form the SEPA area: all European Union member countries plus Iceland, Liechtenstein, Monaco, Norway and Switzerland. For more on SEPA, consult the European Payments Council's website at www.europeanpaymentscouncil.eu or the European Central Bank's website at www.ecb.int.

[6] Killen & Associates (2002), "Optimizing the Financial Supply Chain: How CFOs of Global Enterprises Are Succeeding by Substituting Information for Working Capital", p. 9.

[7] Martin R. Fellenz et al., "Requirements for an Evolving Model of Supply Chain Finance: A Technology and Service Providers Perspective" *Communications of the IBIMA*, volume 10, 2009, p. 232.

[8] Value chain participants located *upstream* from GVC anchors include direct suppliers and all lower tier suppliers. *Downstream* value chain members include all the intermediaries (e.g. wholesalers, retailers) that play a role in making GVC anchors' production available to end users.

The costs associated with financial supply chain inefficiencies

Ingrained and diverse payment and invoicing habits, the number and distance between GVC participants and the propensity of GVC anchors to preserve cash by shifting the burden to other GVC members are all factors that reduce a financial supply chain's efficiency. In practical terms, these factors force upstream and downstream GVC participants to borrow more and for longer periods of time.

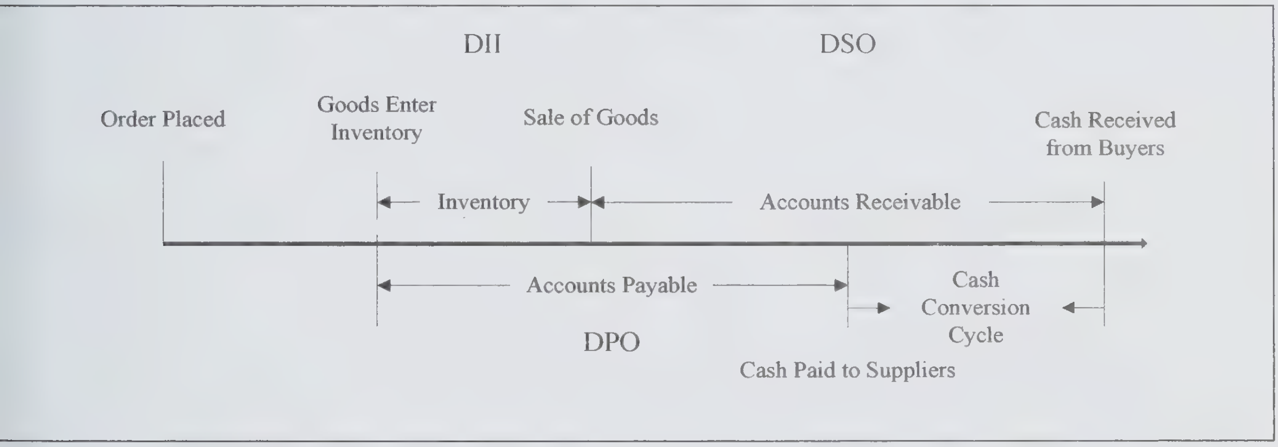
The cash conversion cycle is a commonly-used benchmark used to calculate the timing difference that exists between the moment cash leaves a company to pay suppliers and the time it takes to convert inventory to cash (Figure 2). The longer the cash conversion cycle, the longer the company will need to borrow funds to bridge this gap. The three components of the cash conversion cycle are:

- Days Sales Outstanding (DSO), which measures how long it takes for a company, on average, to get paid;
- Days in Inventory (DII), which measures how long it takes, on average, for inventory to move through a firm's various production stages and be sold; and
- Days Payable Outstanding (DPO), which measures how long it takes for a company, on average, to pay its suppliers.[9]

The relationship between the cash conversion cycle and these three components is:

$$\text{Cash conversion cycle} = \text{DSO} + \text{DII} - \text{DPO}$$

Figure 2. The Cash Conversion Cycle



Source: Prepared by the authors based on a similar chart produced by Global Business Intelligence

Globally, companies that are highly effective at managing their working capital can have cash conversion cycles as low as 15 days.[10] Conversely, inefficient working capital management practices can lead to cash conversion cycles of up to 100 days.[11] Borrowing

[9] DSO, DII and DPO can be calculated as follows using a company's financial statements: DSO = (Accounts receivable / Sales) * 365; DII = (Inventory / Cost of goods sold) * 365; DPO = (Accounts Payable / Cost of goods sold) * 365.

[10] Working capital refers to the difference between the value of a firm's current assets (e.g. cash, accounts receivable, inventory) and current liabilities (e.g. accounts payable, short-term bank debt and, for large corporations, commercial paper). The expression "working capital" is also frequently used, in a generic manner, to refer to the short-term availability of cash within a company (e.g. "company X is trying to find ways to increase its working capital").

[11] Aberdeen Group, "The 2008 State of the Market in Supply Chain Finance", December 2007, p. 9.

funds for an additional 85 days in order to finance the mismatch between the time when suppliers are paid and the moment when sold goods are paid for raises costs for firms and for GVCs. For example, if a Canadian supplier needs to finance a gap of CAD 1 million through its bank line of credit for an additional 85 days, then the incremental interest charges it will need to pay will amount to CAD 9,315 assuming that this supplier borrows at Prime + 1.25% and that the Prime rate is 2.75% (CAD 1 million * 4% * 85 days / 365 days = CAD 9,315). Keeping all other factors constant, if a foreign competitor has a shorter cash conversion cycle, it should be able to offer its products at lower prices and/or be more profitable than the Canadian supplier. This is all the more true if we consider that financing costs can represent as much as five per cent of a company's total cost of goods sold.[12]

There exist several alternatives to borrowing through a bank line of credit in order to finance the cash shortfall that normally characterizes the cash conversion cycle. For instance, the Canadian supplier in the example above could try to receive cash more quickly by offering discounts to buyers if they pay faster or by selling some or all of its accounts receivable at a discount to a factoring company.[13] The problem with these two solutions is that they are generally more costly than borrowing from a bank.[14] Another alternative available to our supplier would be to replicate the buyer's behaviour: that is pay its own suppliers later and request that they hold inventory longer. This approach often produces a domino effect as each subsequent tier of suppliers adopts the same cost-shifting strategy. Since higher financing costs usually get reflected in higher product prices, the end result is a less competitive GVC. The risk of supplier failure within the GVC also rises as the cash conversion cycle of lower-tier suppliers (that typically have a more constricted and costly access to cash) gets extended.

As can be observed, opportunities abound to increase the efficiency of financial supply chains embedded within domestic, regional and global value chains. In response, leading trade finance banks and technology service providers have been developing creative financing solutions and platforms to accelerate and optimize financial flows within GVCs.[15] These solutions and the electronic trade platforms that often act as their backbone are commonly referred to as "supply chain finance" or "supply chain financing" solutions.[16]

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[12] Source: FinListics Solutions, as quoted in Bob Dyckman, "Integrating supply chain finance into the payables process" *Journal of Payments Strategy and Systems*, 3(4), 2009, p. 314.

[13] A factoring company (or "factor") are institutions specialized in purchasing, at a discount, some or all of a company's accounts receivable.

[14] For example, if a supplier offers a 2% discount to a buyer if it pays on day 10 as opposed to day 30, then the cost of financing associated with getting cash 20 days earlier will be 36.9% per annum. If, instead, the supplier sells its accounts receivables to a factor and pays a 1% fee then, assuming that the factor pays the supplier on day 5 and that the receivable is payable on day 30, the cost of financing associated with getting cash 25 days earlier will be 14.7% per annum.

[15] Technology service providers facilitate the process of exchanging purchase orders, invoices, payments and related documents and help integrate this information between buyers, sellers and financial institutions. Orbian, Demica, Bolero, Global SCF and PrimeRevenue are examples of technology service providers active in the field of supply chain finance.

[16] It is worth noting that the development of SCF solutions is not a new phenomenon. For example, paper-based discounting programs that generate similar cash flow improvements and financing cost reductions as supplier payment programs (described in the next section) have existed for at least two decades (on this point, see Marcus Hughes, "The Best Kept Secrets in Supply Chain Finance" *GTNews*, June 26, 2007). During the 1990s, and more so during the past decade when value chains

Supply Chain Finance

Supply chain finance (SCF) solutions represent a combination of technology solutions and financial services that closely connect GVC anchors, suppliers, financial institutions and, frequently, technology service providers. They are designed to improve the effectiveness of financial supply chains by preventing detrimental cost shifting and by improving the visibility, availability, delivery and cost of cash for all GVC participants. They are focused on facilitating trade conducted on an open account basis, which now makes up 80 per cent of world trade.[17] A wide range of industries are well-suited for (and have started to adopt) SCF solutions, including: retailing, automotive, manufacturing, electronics, food and drink, pharmaceuticals, distribution, heavy equipment and technology.[18]

There is, at times, confusion with respect to the difference between trade finance and SCF. Trade finance corresponds to the provision of financing to suppliers to help them produce goods and to foreign buyers to help them purchase these goods. Trade-related supplier financing is often made through loans (e.g. bank line of credit backed by insured foreign accounts receivable) or via the sale of accounts receivable to a factoring company. Buyer financing is usually provided through direct loans made by a financial institution or export credit agency or by the supplier when selling on open account terms. Trade finance also includes the payment instruments commonly used in international trade transactions (e.g. letters of credit and documentary collections) to safeguard the interests of buyers (who want to ensure receipt of the right goods) and suppliers (who want to ensure they are paid). Finally, trade finance includes risk mitigation instruments such as trade credit insurance (that protects suppliers against the risk of non-payment by foreign buyers) and contract bonding (that protects foreign buyers against the risk that the supplier fails to perform its obligations under a commercial contract). As we will see, SCF constitutes an alternative means for suppliers and buyers to gain access to cash. Accordingly, SCF can be considered a sub-set of trade finance.

Supplier payment programs

The most frequently used SCF solution consists of supplier payment programs driven by GVC anchors. The concept behind supplier payment programs is relatively straightforward: the GVC anchor provides access to its lower cost of capital to its key suppliers, enabling them to get paid more quickly and to decrease their financing costs.

Using a shared technology platform, suppliers can request funding from a participating financial institution as soon as a pre-defined event takes place or at any other point in time prior to the scheduled settlement date (Figure 3). Under *pre-shipment* arrangements, suppliers can gain access to cash as soon as a purchase order is received from the GVC anchor. With *post-shipment* structures, the approval of the invoice by the

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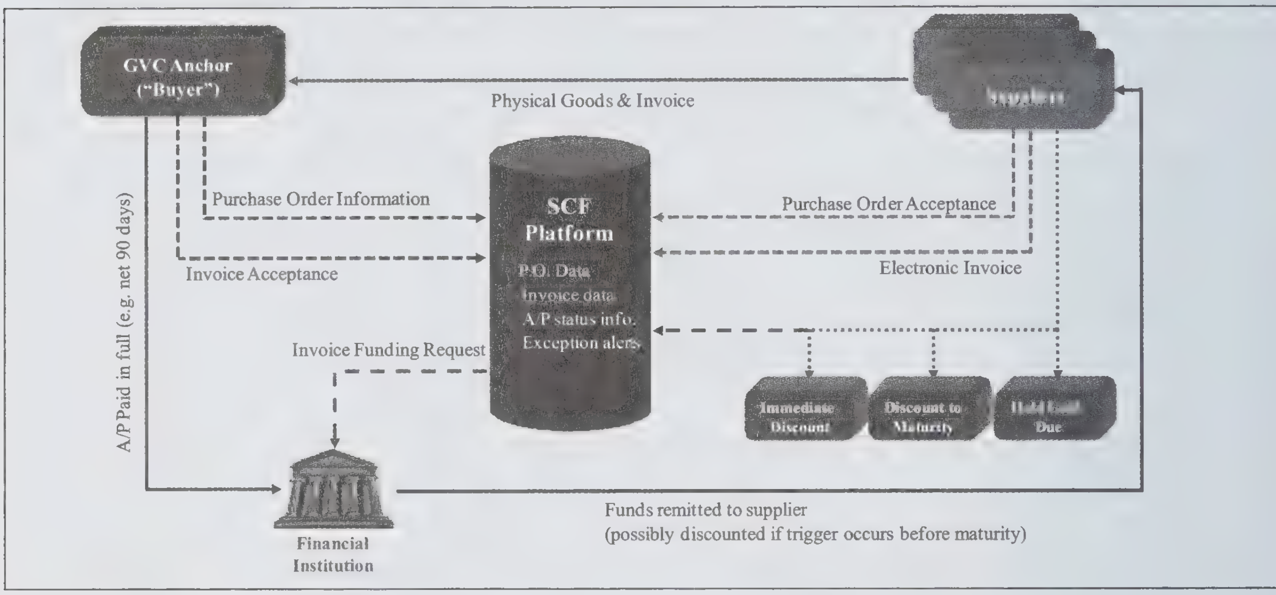
became more global, web-based technologies improved and paper documents started being replaced by electronic documents, the development and distribution of SCF solutions accelerated.

[17] International Chamber of Commerce Banking Commission, "Rethinking Trade Finance 2009: An ICC Global Survey", March 2009, p. 9. Open account trade refers to a payment arrangement whereby suppliers ship goods to buyers and give them an agreed-upon period of time to pay (e.g. 30 days). Other payment methods used in international trade include cash in advance, letters of credit and documentary collections.

[18] Source: Demica, "Demand and Supply, Supply Chain Finance - A Second Report from Demica", May 2008, p. 4.

GVC anchor acts as the trigger that allows suppliers to request an early discounted payment. Once the financial institution receives the request for payment, it can process and transfer the funds to a supplier's bank account in as little as twenty-four hours. At the maturity date of the accounts receivable, the GVC anchor pays the financial institution directly.

Figure 3. Supplier Payment Program



Source: Export Development Canada

Financial institutions participating in supplier payment programs will normally use the face value of the invoice to perform their discounting calculations. This results in greater liquidity being made available to suppliers compared to factoring (where pre-payments are frequently capped at 80 per cent of the invoice amount) or operating lines of credit provided by banks (typically limited to 75 to 90 per cent of the value of accounts receivable, depending if the buyer is domestic or foreign and whether the receivables are insured).

Using the approved invoice as a trigger (i.e. *post-shipment* arrangement) is more common than using the purchase order (i.e. *pre-shipment* arrangement). In this last case, the goods may not yet have been produced by the supplier which results in the financial institution taking on additional risk. The GVC anchor may also make changes to its original purchase order, which adds complexity and increases the risk of disputes between the GVC anchor and its suppliers. Purchase-order-based supplier payment programs are therefore usually reserved for well-established trading relationships.

In order for supplier payment programs to generate cost savings, the GVC anchor's credit rating must be stronger than that of participating suppliers. To date, such programs have normally involved investment grade GVC anchors that have a cost of capital at least 3 percentage points lower than their suppliers. The example presented in Box 1 below illustrates how the cost savings generated by supplier payment programs can be calculated and used by GVC anchors to extend payment terms, extract pricing concessions or get the supplier to support greater levels of inventory - in all cases without causing the supplier's financial condition to deteriorate.

Interestingly, in the aftermath of the financial crisis, GVC anchors began implementing supplier payment programs with the primary motive of stabilising the financial health of upstream GVC members. In other words, these GVC anchors were prepared to let suppliers reap most or all of the financial gains associated with the use of

supplier payment programs in order to reduce the risk of supply disruptions within the GVC.

Box 1. The Cost Savings Generated by Supplier Payment Programs

Let us assume that an emerging market supplier has access to capital at a cost of LIBOR + 5.0 per cent whereas a Canadian GVC anchor, who regularly pays for imported supplies using US dollars, can borrow at LIBOR + 1.0 per cent. If we assume that LIBOR is at 0.50 per cent per annum, then the daily financing cost for the supplier associated with a USD 600,000 order would be USD 91.67 (i.e. USD 600,000 * 5.5 per cent / 360 days). Under a supplier payment program, the supplier's cost of capital could fall to LIBOR + 2.50 (once the bank's profit margin is netted out) which results in a daily financing cost of USD 50.00 (i.e. USD 600,000 * 3.0 per cent / 360 days).[19] The daily savings of USD 41.67 (USD 91.67 minus USD 50.00) can be used as a bargaining chip by the GVC anchor in order to pay later, pay less or hold less inventory.

i) Extending current payment terms: If terms call for payment in 60 days, the GVC anchor could ask for an extension to 110 days without any increase in borrowing costs for the supplier (keeping all other factors constant).[20] The break-even number of days can be found by first calculating what the supplier's borrowing cost is for a 60 day period without the supplier payment program:

Supplier's borrowing cost = (5.5 per cent * USD 600,000 * 60 days) / 360 days = USD 5,500

And then solving for the number of days, keeping the original financing cost in dollars constant and using the supplier's new borrowing cost:

Break-even number of days = (USD 5,500 * 360 days) / (3.0 percent * USD 600,000) = 110 days

This extension of payment terms can help the GVC anchor increase its DPO, thereby reducing its cash conversion cycle and financing costs. In our example, the GVC anchor would have 50 more days to pay (i.e. 110 days - 60 days) which would increase overall company cash flow by USD 83,333 on an annual basis (i.e. USD 600,000 / 360 days * 50 days). The GVC anchor's financing costs would also decrease by USD 1,250 (i.e. USD 600,000 *1.5 per cent * 50 days / 360 days).[21]

ii) Extract supplier price concessions: The GVC anchor could ask, instead, that part or all of the daily savings of USD 41.67 be used to lower unit prices. Over the current 60 day payment period, total interest savings for the supplier amount to USD 2,500 (i.e. 60 * USD 41.67). Keeping all other factors constant, unit costs could therefore decrease by 0.4 per cent (USD 2,500 / USD 600,000) without penalizing the supplier.

iii) Leverage supplier to carry more inventory: Finally, the GVC anchor could ask the supplier to retain ownership of goods on an ongoing basis for an additional 20 days. In connection with an order sold for USD 600,000, the supplier's inventory may be valued at USD 420,000 (assuming a gross margin rate of 30.0 per cent). If the supplier's inventory carrying cost is 10.5 per cent (5.5 per cent cost of financing plus 5 per cent for storage and insurance), its daily inventory carrying cost will be USD 122.50 (10.5 per cent * USD 420,000 / 360). Dividing the total savings of

[19] In practical terms, LIBOR + 3.0 becomes, in this example, the discount rate that would be used by the bank once the supplier requests that a purchase order, invoice or account receivable be discounted. To reap the full benefit of this lower cost of capital, the supplier should request payment as early as possible under the supplier payment program.

[20] The extension to and even past the 120 day mark for the accounts payable of GVC anchors is now commonplace. When GVC anchors are retailers, the days payable outstanding can now reach 200 days or higher, something that was unheard of just a few years ago.

[21] This amount of savings may appear like a small sum on its own, but when multiplied by the thousands of purchasing transactions a GVC anchor conducts every year, the savings can become significant.

USD 2,500 (calculated above) by the daily inventory carrying cost of USD 122.50 yields the 20 day break-even extension for the inventory carry period.

Source: Prepared by the authors based in part on an example presented in Dyckman, *op. cit.*, p. 314

Aside from lowering financing costs, supplier payment programs can provide other advantages to GVC anchors and their suppliers. Table 1 outlines some of these other operational benefits and summarizes the main financial benefits of supplier payment programs.

Table 1. Benefits of Supplier Payment Programs

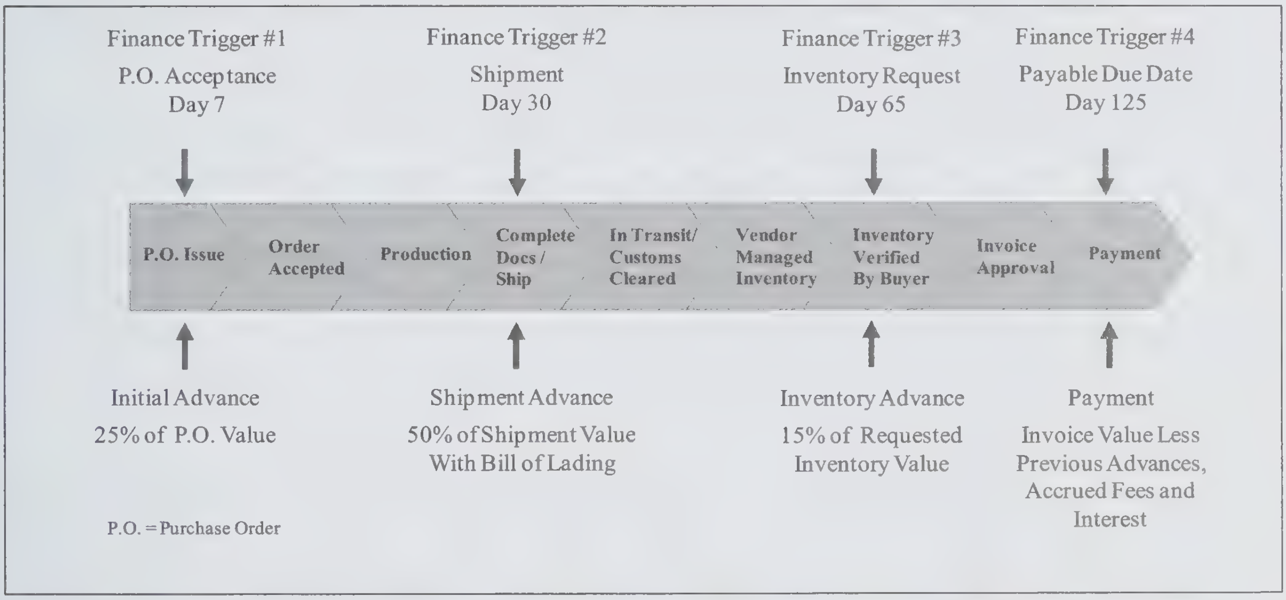
BENEFITS FOR GVC ANCHORS (BUYERS)	BENEFITS FOR SUPPLIERS	BENEFITS FOR GVC ANCHORS AND SUPPLIERS
➢ Increase in DPO and drop in DII ➢ Cost of goods sold may drop due to lower negotiated input prices ➢ Cost of processing payments to suppliers decreases as it is now performed by the financial institution	➢ Ability to discount purchase orders, invoices or accounts receivable early and with ease ➢ Ability to obtain more cash at a cheaper rate than through the use of discounts, factoring or a bank line of credit ➢ Reduction in DSO ➢ Savings produced by the supplier payment program can help offset the cost associated with a GVC anchor's request to extend payment terms, carry more inventory or reduce prices ➢ Increases certainty of payment and eliminates the need for credit insurance for sales to GVC anchors	➢ Reduction in the cash conversion cycle ➢ Financing costs decrease ➢ Helps establish a more collaborative relationship ➢ Enhances the stability and competitiveness of GVCs ➢ Improved visibility of cash flow achieved through the SCF technology platform ➢ Better cash flow forecasting ➢ SCF technology platform encourages automation of financial supply chain processes (e.g. ordering, invoicing) which can significantly reduce administration costs

Source: Prepared by the authors

Other supply chain finance solutions

SCF solutions include other types of financing options that can help cut costs and improve GVC efficiency. For example, *in-transit inventory financing* can assist small and medium-sized exporters or importers gain access to cash while goods are being delivered in cases where they retain ownership of goods in transit. *Raw materials inventory financing* can help suppliers obtain lower prices on physical inputs by allowing them to order larger quantities. This can be accomplished by leveraging a GVC anchor's purchasing power with lower-tier suppliers and/or its banking relationships. *Vendor managed inventory financing* can support suppliers that sell to GVC anchors that operate just-in-time inventory systems.[22] In this case, GVC anchors usually want to receive (and be invoiced for) components only when they need and use them. This approach can put a lot of pressure on suppliers who must finance inventory for lengthier periods of time. A SCF solution can be crafted for such cases whereby a varying percentage of the purchase order value can be advanced to the supplier following the completion of pre-determined stages (Figure 4).

Figure 4. Event-Triggered Supply Chain Financing Solution



Source: Prepared by the authors based, in part, on a similar chart produced by Global Business Intelligence

Finally, looking further downstream along the value chain, *distribution financing* allows GVC anchors to remove inventory from their books more quickly and to accelerate cash inflow through the early discounting of receivables. Distribution financing programs are similar in structure to supplier payment programs except that GVC anchors now act as suppliers and look to SCF to reduce DII and DSO (as opposed to increasing DPO). The burden for distributors of having to carry more inventory, sooner, is offset by giving them more time to pay.[23] At invoice maturity, the distributor pays the financial institution instead of the GVC anchor.

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[22] In this setting, the term "vendor" has the same meaning as "supplier". Vendor managed inventory financing is at times referred to as *consignment stock financing*.

[23] In some cases, gaining access to larger quantities of inventory can help distributors increase revenues. This will be the case, for example, with products exhibiting seasonal sales patterns such as outdoor sporting goods (where the costs associated with stock outs is high) or that come in many different models or with different features such as automobiles or televisions.

Distribution financing is less appealing for financial institutions than supplier payment programs since distributors' credit quality is not as high, usually, than that of GVC anchors. Further, credit will need to be assessed and monitored for numerous distributors as opposed to a single entity under supplier payment programs. For this reason, many financial institutions are only prepared to provide distribution financing if they have recourse back to the GVC anchor.

A majority of early adopters of SCF report that these solutions have performed as intended: financing costs have been lowered, unit costs of procured goods have declined, DPOs have been lengthened, DSOs shortened and supply disruptions reduced.[24] Despite this, the usage rate for SCF solutions remains relatively low. We examine why next.

The Current State of Supply Chain Finance

Although SCF has grown rapidly during the past few years (spurred along, namely, by the financial crisis), it remains a category of trade finance solutions that is in an early stage of development. For instance, a survey conducted in May 2010 found that only twenty-five per cent of European corporations were using SCF solutions (a strong increase from the previous year when only fifteen per cent of respondents indicated they used SCF).[25] The usage rate for SCF is believed to be at least as high in the United States but lower in Canada due, in part, to the relatively small number of GVC anchors located in Canada.

Many factors explain why, despite the benefits that they can bring, SCF solutions have not been adopted by more GVC participants. The reasons most frequently identified by scholars, SCF providers and supply chain experts are outlined below.

Demand-side impediments:

- Lack of understanding by GVC anchors and suppliers of the concept, costs and benefits of SCF
- Resistance to change within GVC anchors and supplier firms
- Costs and efforts required by GVC anchors to sign up suppliers and distributors to SCF programs
- Suppliers wary of embarking on programs driven or imposed on them by GVC anchors
- Difficulty or inability of suppliers to get their bank to release their security interest in the accounts receivables owed by GVC anchors
- Concerns with systems integration costs on the part of suppliers who risk having to deal with multiple, non-compatible, SCF platforms when selling to more than one GVC anchor

Supply-side impediments:

- A limited number of banks offer supply chain financing solutions and an even lower number (mostly the top global banks) offer comprehensive suites of SCF solutions[26]

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[24] See Aberdeen Group, *op. cit.*, p. 7.

[25] Source: Demica, June 2010, *op. cit.*, p. 7.

[26] Top global banks presently dominate the SCF landscape. The most active in this space included, at time of writing, Citi, Bank of America, Wells Fargo, J.P. Morgan, Deutsche Banks, Banco Santander, HSBC and Standard Chartered Bank.

- Low-margin business for banks who therefore request high transactional volumes in order to accept suppliers under supplier payment programs
- Limited risk appetite by banks to put in place supplier payment programs when the buyer is not an investment grade risk
- Limited risk appetite of many banks for upstream (e.g. in-transit inventory financing) and downstream (e.g. distribution financing) SCF exposures
- Inability of banks to provide, on their own, sufficient SCF capacity to some GVC anchors due to credit constraints
- Costly for banks to develop, on their own, the technology to support their SCF activities[27]
- Cumbersome and costly for banks to perform due diligence and perfect their security interests when their footprint is minimal in suppliers' or distributors' home country
- Bank contact points within GVC anchors and suppliers tend to be with finance and treasury people whereas in many cases the procurement office would be a more appropriate point of contact

Technological/regulatory impediments:

- Lack of a standard technology with respect to corporations', banks' and technology service providers' supply chain financing platforms - which increases complexity and costs for users
- Lack of automation within the financial supply chain and of connectivity with the physical supply chain
- Challenges associated with the development of technology solutions that allow for the provision of multiple forms of SCF solutions as well as other trade-related bank services (e.g. cash management and treasury)
- Lack of confidence in electronic security and the legality of electronic signatures or complex e-security processes[28]
- Accounts payables have at times been treated as bank debt (notably in the United Kingdom and in the United States) when processed through supplier payment programs – which acts as a deterrent to their adoption for some GVC anchors[29]
- Basel III could increase the cost or reduce the supply of SCF due to a proposed increase on capital requirements for trade finance transactions[30]

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[27] Banks don't have to develop their own SCF platforms. They can use, instead, applications developed by technology service providers or by other banks. Nevertheless, for strategic reasons some banks wish to differentiate themselves from their competitors through their SCF platform and do not wish to become dependent on an external party's technology. For more on this issue, see Liz Salecka, "Accelerating Supply Chain Finance" *Global Trade Review*, September/October 2009.

[28] For example, Canada's current regulations on electronic signatures, adopted in 2005, include stringent requirements for an electronic signature to be treated as "secure" and thus equivalent to a manual signature affixed on a paper document. For the text of the regulation see *Secure Electronic Signature Regulations [SOR/2005-30]* at http://laws.justice.gc.ca.

[29] The reclassification of trade payables as bank debt can be problematic if it leads to loan covenants relating to bank indebtedness to be breached or if the reclassification stands to significantly distorts a GVC anchor's financial ratios (e.g. days payable outstanding).

[30] BAFT-IFSA (2010), "Joint Industry Letter Warns Basel III Could Slow Economic Recovery", News Release, November 2, 2010. The Canadian Bankers Association is a member of BAFT-IFSA.

The Outlook for Supply Chain Finance

Many efforts have been deployed by GVC anchors and other GVC participants over the past few years to extract as much cash as possible from accounts receivables, accounts payables and inventory. As a result, and in light of the tentativeness of the economic recovery, further use of conventional (i.e. non-SCF) approaches by GVC members to improve their cash conversion cycle appears impractical. This was confirmed in a survey conducted in 2010 where sixty-three per cent of European corporations believed that some of their key suppliers would not be able to sustain a further lengthening of payment terms.[31] The demand for SCF is therefore expected to grow in the future based, in large part, on the ability that SCF solutions provide to improve the cash conversion cycle of GVC anchors without bringing about detrimental cost shifting within the value chain.

Supply-side issues may unfortunately make it difficult to meet this expected rise in SCF demand. Financial institutions remain very cautious when deploying their capital in the current post-crisis environment. The new, more stringent, Basel III capital requirements will almost certainly add to this caution. These factors, combined with the relatively low risk-adjusted rates of return that SCF solutions generate, may therefore make it difficult for banks to meet the increased demand for SCF.

Over the coming years, the priority of banks that offer SCF solutions will likely be on servicing existing corporations, on trying to acquire new investment grade accounts and, for those with proprietary SCF platforms, on competing with technology service providers. Although the reach of the latter should continue to expand in the future, their ability to grow will ultimately depend on how much credit capacity banks are willing to dedicate to SCF. In this context, non-bank financial institutions are expected to play a more active role in responding to rising SCF demand. A rise in the offer of new short-term financing solutions, such as The Receivables Exchange, is also to be expected.[32]

Concerning technology, the presence in the market of non-compatible SCF platforms (i.e. those offered by banks and technology service providers or developed in-house by GVC anchors) is expected to continue over the short to medium term. Many corporations and global banks have made significant investments in SCF technology that they will want to recover. Over time, however, it may become difficult for these organizations to justify spending considerable sums of money to maintain, develop and upgrade their in-house applications when state-of-the-art technology can be purchased or obtained as a managed service at a lower cost. The recent rise in popularity of "bank neutral" SCF platforms (i.e. not funded and operated by a single financial institution) offered by technology service providers should also help reduce the number of different platforms available on the market. Some GVC anchors appreciate these SCF platforms as they allow them to spread

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It was a signatory to a letter issued on the same day as the news release which expressed the concerns of many BAFT-IFSA members over the impact of new Basel III capital requirements on the availability and cost of trade finance.

31 Demica, June 2010 report, *op. cit.*, p. 7.

32 The Receivables Exchange (www.receivablesxchange.com) is an online marketplace for real-time trading of accounts receivable that was created in 2007. Receivables on the Exchange are sold by American companies (typically small and medium-sized enterprises) and purchased by a global network of accredited institutional investors. Just like SCF, the Exchange constitutes an alternative to traditional trade finance methods that can help provide liquidity to GVC participants through a cost-effective mechanism. Unlike SCF, however, the Exchange only allows accounts receivable (and not buyer-approved invoices or purchase orders) to be sold and does not help strengthen ties between GVC participants.

their funding sources. Certain banks also appreciate them as they help them diversify their credit exposures. Finally, as opposed to competing for the business of both the GVC anchor and its suppliers, banks are beginning to partner more frequently using common SCF platforms. For all of these reasons, a smaller number of interoperable SCF platforms is expected to characterize the SCF marketplace over the medium term. This in turn should help make SCF solutions accessible to a larger number of GVC participants.

In regards to automation and connectivity between the physical and financial supply chains, many (often regional) initiatives are expected to greatly accelerate the adoption of e-invoicing and the elimination of printed commercial, transport and customs documents over the coming years. The more prominent plans being developed include APEC's Strategies and Action Toward a Cross-Border Paperless Trading Environment, the Pan-Asia E-Commerce Alliance, the European Commission's European Electronic Invoicing Framework, SWIFT's Trade Services Utility and both APEC's and ASEAN's Single Window Initiatives.[33] The elimination of paper and true codification of documents (as opposed to simply scanning them) achieved through the above plans will eventually save time and money for GVC members. They will also stimulate the development of interoperable platforms that permit the processing and tracking of physical and financial supply chain data and events. Finally, they will create opportunities for banks to provide financing and other financial services at various points along the financial supply chain.[34]

Supply Chain Finance in Canada

There are few publicly-available statistics to quantify the adoption rate for SCF in Canada. The consensus viewpoint, however, is that SCF remains nascent in Canada. In addition to factors hindering the growth in SCF globally, issues specific to the Canadian marketplace delay the use of SCF by Canadian members of GVCs.

On the demand side, the difficulty that Canadian suppliers face when trying to get their bankers to carve out receivables owed by GVC anchors from existing security agreements has had a restraining effect on demand for SCF in Canada. Also, the comparatively low use of factoring by Canadian companies (except in a few industries, such as apparel) may have indirectly depressed demand for SCF.[35] As well, supply chain management practices in Canada have tended (to date) to discourage the adoption of SCF since a relatively small proportion of Canadian businesses view their supply chains in a strategic manner. For this reason, few companies are equipped from an internal process

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[33] Single window initiatives aim to facilitate the acquisition by exporters and importers of all government approvals that they require through a unique point of access. They are being developed at both regional and national levels. In Canada, the Canada Border Service Agency is responsible for the development and implementation of the country's single window initiative. For more details on the main regional and national single window initiatives, including that of Canada, consult the World Customs Organization's website at www.wcoomd.org.

[34] For example, banks could offer buyers and suppliers document matching and reconciliation services (e.g. verifying that the commercial invoice, transport, insurance and customs documents contain consistent information that matches with the original purchase order). They could also better price loans based on the knowledge of when a specific financial supply chain event has taken place (e.g. a GVC anchor has received goods and approved a supplier's invoice).

[35] In Canada, factoring is commonly perceived as a financing tool reserved for companies with weak financials. This negative stigma could have a moderating effect on the degree of interest of Canadian exporters for supplier payment programs which, like factoring, involve the early discounting of amounts to be paid by buyers.

(e.g. collaboration between finance and procurement) and technology perspective (e.g. use of e-invoicing) to take advantage of the benefits that SCF solutions can bring.

On the supply side, the offer for SCF solutions is limited at present in Canada. Although most Canadian financial institutions provide customized receivables purchase programs for their large corporate clients, only a small number have developed supplier payment programs or distributor financing solutions.[36] The absence of legislation in Canada on *electronic* bills of exchange is a source of concern for some Canadian banks.[37] More fundamentally, the limited number of investment-grade GVC anchors in Canada tends to make it a relatively unattractive market to pursue for Canadian and global banks and for technology service providers.[38] Also, SCF solutions compete with traditional bank lending and trade finance products while offering lower risk-adjusted returns. Lastly, Canadian financial institutions have been reluctant to partner with each other to offer SCF solutions, preferring instead to compete for the business of both buyers and suppliers.

On the technological front, as indicated previously Canada (just like the United States) lags the rest of the world with respect to the use of electronic payments and it will probably take at least a decade before the gap between payment practices in Canada and those observed in leading-edge jurisdictions (such as Finland) is narrowed. Canada also lags Europe, Asia and parts of Latin America considerably in regards to replacing paper-based business and trade documentation with electronic versions. These delays hurt the competitiveness of Canadian segments of GVCs by slowing the adoption of today's technology-driven SCF solutions.

Canadian suppliers potentially at risk

An important present-day trend in supply chain management involves GVC anchors reducing the number of their suppliers and simultaneously developing closer ties with remaining suppliers. SCF solutions can help develop strong ties between trading partners and are expected to be used in part for this purpose by GVC anchors in the future. Because of the low rate of automation of financial flows and the limited offer for SCF in Canada, some Canadian exporters may be at risk of being excluded from the supplier base of American and foreign GVC anchors. The reluctance of many global SCF banks (with which these GVC anchors work) to perfect their security interests in Canada and to fulfill know-your-client rules with Canadian-based suppliers compounds this risk.[39]

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[36] At time of writing, the Bank of Montreal, National Bank and the Bank of Nova Scotia were the main Canadian financial institutions that offered, in varying degrees, supplier payment programs.

[37] A bill of exchange (often called a draft) is a commonly used financial instrument in international trade transactions. It is an unconditional order in writing from the exporter to the importer requiring the importer, if it accepts the order, to make payment on demand to the exporter on the payment due date.

[38] At time of writing, Citi and HSBC were the only global banks actively promoting their SCF services in Canada.

[39] Know-your-client (KYC) rules correspond to the due diligence that banks are required to perform to identify their clients and confirm relevant information prior to doing business with them. KYC rules aim to combat, in particular, money laundering, terrorism financing and identity fraud. When a bank does not have a significant footprint in Canada, performing this due diligence can be costly and time consuming. The same issue arises with respect to the perfection of banks' security interests (i.e. it is more complex for foreign banks with a minimal presence or no presence at all in Canada to secure their rights and title to Canadian suppliers' foreign receivables).

From a public policy perspective, a rationale appears to exist to support the participation of Canadian exporters in GVCs through measures that support the conversion to electronic documentation and payment systems and that stimulate the availability of SCF solutions for firms that would like to obtain them. Working in collaboration with Canadian financial institutions, Export Development Canada (EDC) already provides some forms of SCF support, particularly in respect of the auto sector where supply chain financing has been used for many years. Given current market conditions for SCF in Canada, EDC is presently examining various ways to facilitate access to SCF in order to safeguard Canadian exporters' current and future participation in GVCs. Injecting liquidity into supplier payment programs put in place by global SCF banks (who are typically eager to transfer risk off their balance sheets) could be one way to encourage these banks to overcome their reluctance to include Canadian suppliers in supplier payment programs developed for GVC anchors.

Better supporting Canadian upstream GVC suppliers

Most SCF solutions today are enacted between GVC anchors and their direct (i.e. tier 1) suppliers. Given the limited number of Canadian GVC anchors, any significant SCF growth in Canada will need to take place through the tapping, by banks and technology service providers, of new segments along the financial supply chain. One of these segments is non-investment grade Canadian exporters.[40] Making supplier payment programs available to non-investment grade exporters in Canada would improve the efficiency of their financial supply chains and help them consolidate their position within the GVCs in which they participate. Another segment is Canadian sub-suppliers (i.e. suppliers more than one step removed from the Canadian exporter). Increasing the offer of SCF solutions to Canadian sub-suppliers could play an important role in enhancing the competitiveness and stability of Canadian segments of GVCs by improving small Canadian suppliers' access to capital.

Improving financial flows within all portions of GVCs may soon become the next frontier that helps further enhance GVC collaboration, effectiveness and cost control objectives. Canadian banks are well-positioned to deliver SCF solutions to non-investment grade Canadian exporters and to lower tier Canadian suppliers since they act, in the majority of cases, as their primary bank. However, as previously outlined, many factors currently restrain the appetite of Canadian financial institutions with regards to SCF. Enhanced collaboration between Canadian banks and global banks, technology service providers and credit insurers could make it easier for Canadian banks to offer SCF solutions to non-investment grade Canadian GVC members. For instance, a large number of global banks license their SCF technology. To reduce the costs of implementing an SCF program, Canadian banks could look at leveraging those infrastructures which are expensive to develop, maintain and upgrade. Another example might be for Canadian banks to work more closely with credit insurers in order to mitigate their exposure to non-investment grade Canadian GVC participants. Unfortunately, cooperation of this nature is unusual in today's marketplace which is why a public policy response may be warranted in order to help address these gaps. The issue of financing gaps in Canada and how SCF solutions could help fill some of these gaps is explored in the next section.

[40] Some non-investment grade Canadian exporters can represent good quality credits. They may just be too small to be rated, thus officially making them non-investment grade.

Supply Chain Finance in Canada: A Solution for Credit Market Gaps?

The current state of SCF in Canada suggests elements of credit market failure are at play. The common view is that financing gaps, especially for smaller companies, arise when companies are unable to obtain as much debt as they request. Riding and Belanger note that these credit shortfalls are not evidence of financing gaps, as not all applications for credit should be granted. [41] The OECD further notes that the "supply of credit is not inexhaustible" and that some borrowers will be turned down due to the normal operations of credit allocation within capital markets.[42] Riding and Belanger succinctly summarize the literature on what constitutes a credit market gap:

1. among loan applicants who appear identical, some receive credit while others do not; or,
2. there are identifiable groups in the population that are unable to obtain financing at any price.

Empirical studies and surveys indicate financing gaps do exist in Canada and elsewhere.[43] Credit rationing affects smaller and new firms more so than larger firms and can be viewed as a natural state of affairs resulting from gaps in the credit markets.[44] As a firm grows in size, its access to credit becomes easier and less costly. The end result is smaller firms have less capacity to take advantage of growth opportunities. The evidence further suggests this outcome is more pronounced for exporters.[45]

Economic theory argues that market gaps arise in the presence of information asymmetries and externalities. Information asymmetries occur when the borrower (e.g. small company) and lender (bank) do not share the same information. In the case of financing, banks often lack complete information on companies' credit profiles, leading to restrictions on lending. Externalities refer to situations in which a cost or benefit is borne by parties outside the activity. A positive externality occurs when the activity being undertaken provides benefits to third parties. In such cases however, the good or service will be underproduced. The producer will only supply enough to maximize its own internal profits, which means that all of the benefits that could have accrued to third parties are not fully realized.

In the past few years, supplier payment programs have become largely synonymous with what most people consider to be a SCF program. The discussion here therefore focuses on supplier payment programs. A study on SCF by the Bank of England notes two key characteristics of these types of programs.[46] First, the buyer (not the lender) takes responsibility for the supplier (e.g. quality of goods, return of faulty goods, etc). Second, the cost of financing for GVC participants is based on the credit rating of the buyer and not the individual suppliers. The deployment of SCF programs can therefore address some

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[41] Allan Riding and Brad Belanger (2007), "Minding the Gap: Assessment of Financing Gaps Related to SME Exporters in Canada", University of Ottawa School of Management and Industry Canada.

[42] OECD, "The SME Financing Gap, Volume 1: Theory and Evidence", 2006.

[43] *Ibid.* and Hall, Peter and Todd Evans, "Minding the Gap: An EDC Assessment of Financial Intermediation Gaps in Canada," Export Development Canada, 2005.

[44] OECD, International Conference on SMEs, Entrepreneurship and Innovation, Issues Paper, 2009.

[45] Riding and Belanger, *op. cit.*

[46] Bank of England, "Supply Chain Finance", Report of the Supply Chain Finance Working Group, July 2010.

of the credit gap faced by small companies - by removing information asymmetries, and by capturing positive externalities.

1. *Information asymmetry.* In this case, the bank lacks sufficient credit information to extend financing to all suppliers and sub-suppliers in the GVC. Without adequate financial information for suppliers in the GVC, banks tend to restrict financing to a small number of large suppliers where detailed credit info is easier to obtain. The end result is restricted access to credit, and more stringent payment and delivery terms across the entire value chain. However, when a GVC anchor or buyer takes on the risks of its suppliers, the informational asymmetry is effectively removed as the bank now only has to understand the credit risk of the buyer. This allows the lender to extend credit to multiple suppliers selling to an identified buyer within a GVC.
2. *Positive externalities.* A positive externality exists when the bank's costs of establishing a SCF platform outweighs its own benefits, which leads the bank to restrict any development of a SCF platform, even though third parties would benefit. Presently, SCF services are offered to GVC anchors and a limited number of larger suppliers. Many of Canada's smaller suppliers and sub-suppliers would benefit from a SCF program through lower financing costs, lower administrative costs, and increased sales. But the SCF service is "under-produced" because a common platform is not available to a wider number of suppliers. This is a case where the bank's "private" benefits do not justify their costs, thereby leading to an undersupply of the good in question, and reducing the "social" benefits to third parties. With a SCF platform available to more suppliers, the demand for such service is created, which allows the cost savings to be captured by more of the GVC participants.

There appears to be a SCF gap in Canada given that more suppliers are likely to use SCF programs if given the opportunity. SCF programs accessible to a larger number of upstream suppliers (i.e. tier 2 and 3) can help address credit market imperfections, and potentially increase the supply of credit to smaller companies. A common platform where financial information on GVC buyers and suppliers can be accessed easily by SCF providers would reduce information asymmetries, and reduce bankers' apprehension in extending credit and other payment terms to a larger number of GVC participants.

The size of the Canadian customer base that is currently able to meet the eligibility criteria for SCF support is small. This limits the scale economies required for most financial institutions to justify the cost of establishing a comprehensive range of SCF programs for the benefit of Canadian exporters and their suppliers. The lack of scale raises the cost of these programs, effectively creating a barrier for financial institutions (whether Canadian or foreign) to expand their financial services in this space. The end result is a small number of SCF providers operating in Canada, which creates an oligopolistic situation that reduces the availability of SCF products for Canadian companies that are members of GVCs.

Given the relatively smaller number of GVC anchors and tier-1 suppliers in Canada, offering SCF programs further upstream along GVCs (i.e. to more sub-suppliers) can provide the necessary critical level of revenues to financial institutions to justify the cost of establishing and maintaining a SCF infrastructure. Economic theory argues that banks and financial service providers need a customer base of sufficient size in order to diversify and reduce risk. Although the majority of new customers in a GVC are likely to be small sub-suppliers and carry relatively more risk, spreading this risk across a larger pool of

companies reduces the potential downside of one or more firms failing.[47] But improving access to credit does not complete the story here - as identified previously, there are many other impediments to the participation of Canadian suppliers of all sizes in SCF programs (e.g. low usage rate of e-invoicing and e-payment; negative perception of programs that allow for the discounting of accounts receivable, etc.).

Role of Public Policy

Smaller companies typically face constraints in accessing credit. Fallout from the recent financial crises suggests financing will remain relatively tight through the next few years, as banks and other lenders maintain cautious lending practices. SCF programs offer a means to alleviate credit shortfalls. In addition, SCF programs reduce costs and introduce efficiencies across the entire value chain - to the benefit of individual participants and the broader economy.[48] The economy-wide benefits and competitive gains stemming from SCF programs provides motivation for public sector participation in SCF technology and related infrastructure (e.g. through a cost-sharing with banks and industry associations). The broader economic and financial payback of SCF infrastructure suggests government could play a policy role in catalyzing the formation of a SCF platform, possibly through direct investment and technical support, or indirectly via regulatory changes and tax credits.

On the trade side, the relative absence of GVC anchors and SCF platforms in Canada suggests Canadian companies are at a disadvantage in competing for business in international markets. Canadian trade and investment policy should therefore consider strategies to improve Canadian companies' access to global SCF platforms. These strategies could be included in bilateral and multilateral negotiations. Adopting such policies could broaden Canada's commercial connections to non-US markets, potentially allowing more Canadian companies to tap into faster growing emerging markets.

Conclusion

The interest in SCF has risen considerably in Europe and the United States over the past five years. In Canada, a variety of factors have led to a more subdued interest in SCF, but this is slowly changing. During this recent period, an increasing number of GVC participants have realized that the traditional arm-wrestling relationship between buyers and suppliers is detrimental to overall GVC competitiveness and resiliency. As a result, demand rose during the credit crisis and continues to rise today for innovative financing solutions that permit GVC companies to improve their cash conversion cycles without negatively impacting other GVC members.

SCF solutions can help achieve such an outcome. They can also reduce financial supply chain inefficiencies by encouraging process automation and providing greater visibility and predictability throughout the sequence of financial supply chain events. Further, they give financial institutions the opportunity to offer financing triggered by financial supply chain events and to deliver new value-added services by leveraging the data flowing through their SCF platforms. Ultimately, all of these benefits allow GVCs

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[47] By participating in a GVC and having access to SCF, a small sub-supplier is likely to carry less risk, on average, compared with an independent supplier not associated with a GVC.

[48] Bank of England, *op. cit.*

and GVC companies to become more cost-efficient, stable and successful, which explains why demand for SCF solutions is expected to continue growing over the coming years.

Unfortunately, supply-side issues are likely to limit the access to SCF solutions in all major markets over the near to medium term. Even sizeable GVC anchors with robust balance sheets and high trading volumes may find it difficult to obtain the amounts of SCF support they require due, in part, to banks' limited desire to hold large trade finance exposures. As we have seen, a number of additional issues curtail even further the availability of SCF in Canada. These include the restrained appetite of Canadian banks for SCF and the reported reluctance of some global banks to include Canadian exporters in supplier payment programs. A shortage of SCF could jeopardize the export sales of some Canadian exporters that sell to U.S. or foreign-based GVC anchors. It could also hamper the competitiveness of Canadian segments of GVCs by preventing Canadian suppliers and sub-suppliers from accessing new technology platforms and cost-efficient forms of short-term capital. For these and other reasons outlined in this paper, a public policy response could be in order to help correct the observed gaps in the availability of SCF solutions in Canada. Future research in this area would ideally aim to quantify the current SCF gap as well as the costs associated with the existence of this gap.

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Logistics and the Competitiveness of Canadian Supply Chains

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Introduction

In 2009, Canada ranked ninth among OECD countries with a per capita gross domestic product (GDP) of $46,243,[1] a measurement generally used to compare societies' standards of living. That same year, our main trading partner, the United States, ranked third with a per capita GDP of $56,109—21.3% higher than the figure for Canada. It is generally acknowledged that an increase in a country's standard of living is linked to growth in labour productivity, that is, the relationship between the GDP and the number of hours worked. Based on this criterion, Canada placed 17th among OECD countries in 2009, with labour productivity of $53.79 per hour worked, while the United States ranked 7th, with labour productivity of $64.91—20.7% higher than the figure for Canada. This lag on Canada's part is nothing new. Between 1981 and 2009, average annual labour production growth in Canada was among the lowest for industrialized OECD member countries. In fact, only Italy and Switzerland had lower growth rates during that period.[2]

Between 1984 and 2006, growth in labour productivity in Canada came essentially from the services sector, including a positive contribution from the wholesale and retail sectors. However, virtually none of this growth came from the transportation and warehousing industry.[3] More recently, between 2002 and 2008, the increased labour productivity in Canada's retail sector was much higher than the private sector average. This good performance may be attributable to investments made by companies in that sector in innovative practices, particularly in the area of logistics management (Industry Canada, 2010).

It is therefore appropriate and important to compare Canada's supply chain management performance, both in terms of international trade and from the perspective of innovative practices adopted by Canadian companies in the domestic market. This chapter begins with a comparative analysis of Canada's performance with the performance of 155 countries from the perspective of their global supply chain as measured by an index developed by the World Bank. Next, the relationship between logistics performance and business productivity is

[1] Canadian dollars in 2008.

[2] Centre sur la productivité et la prospérité (2010), *Productivité et Prospérité au Québec – Bilan 2010*, HEC Montréal.

[3] Ibid

examined. In the third section, the logistics performance of Canadian companies is compared with the performance of American companies on the basis of various cost categories and by key economic sector. The fourth section covers innovative practices for managing supply chains and the degree of success achieved by Canadian companies in adopting these practices. The chapter concludes with final observations and implications for government decision makers and policy.

1. Comparative analysis of the performance of global supply chains

The World Bank has just published its second classification of countries based on a Logistics Performance Index (LPI) it developed using the following six criteria (Arvis et al., 2010).

1. Efficiency of the customs clearance process and security measures
2. Quality of transport-related and communication infrastructure
3. Ease of arranging competitively priced international shipments
4. Competence and quality of logistics services
5. Ability to track and trace consignments
6. Frequency with which shipments reach the consignee within the scheduled or expected time.

This index is calculated on a scale of 1 to 5, with a rating of 5 for the best performance and 1 for the worst. It is obtained for 155 countries by assessing each of the criteria listed above using a questionnaire sent to nearly 1,000 managers and specialists working for freight forwarders (e.g., DB Schenker, Kuehne + Nagel and Panalpina) and international courier companies (e.g., DHL, Fedex and UPS). The scores obtained for each of the six criteria used are statistically analyzed using principal component analysis in order to obtain a composite index of logistics performance. The results are presented in Table 1.

Table 1: Classification of the 20 leading countries based on the World Bank's international Logistics Performance Index (LPI)

			Criteria Rank and Score					
Rank	Country (or territory)	LPI	Customs (rank) score	Infrastructure (rank) score	International Shipments (rank) score	Logistics Competence (rank) score	Tracking and Tracing (rank) score	Timeliness (rank) score
1	Germany	4.11	(3) 4.00	(1) 4.34	(9) 3.66	(4) 4.14	(4) 4.18	(3) 4.48
2	Singapore	4.09	(2) 4.02	(4) 4.22	(1) 3.86	(6) 4.12	(6) 4.15	(14) 4.23
3	Sweden	4.08	(5) 3.88	(10) 4.03	(2) 3.83	(2) 4.22	(3) 4.22	(11) 4.32
4	Netherlands	4.07	(4) 3.98	(2) 4.25	(11) 3.61	(3) 4.15	(9) 4.12	(6) 4.41
5	Luxembourg	3.98	(1) 4.04	(9) 4.06	(7) 3.67	(21) 3.67	(19) 3.92	(1) 4.58
6	Switzerland	3.97	(12) 3.73	(6) 4.17	(25) 3.32	(1) 4.32	(1) 4.27	(15) 4.20
7	Japan	3.97	(10) 3.79	(5) 4.19	(12) 3.55	(7) 4.00	(8) 4.13	(13) 4.26
8	United Kingdom	3.95	(11) 3.74	(16) 3.95	(8) 3.66	(9) 3.92	(7) 4.13	(8) 4.37
9	Belgium	3.94	(9) 3.83	(12) 4.01	(26) 3.31	(5) 4.13	(2) 4.22	(12) 4.29
10	Norway	3.93	(6) 3.86	(3) 4.22	(24) 3.35	(13) 3.85	(10) 4.10	(10) 4.35
11	Ireland	3.89	(18) 3.60	(19) 3.76	(5) 3.70	(16) 3.82	(13) 4.02	(4) 4.47
12	Finland	3.89	(7) 3.86	(8) 4.08	(19) 3.41	(10) 3.92	(11) 4.09	(25) 4.08
13	Hong Kong	3.88	(8) 3.83	(13) 4.00	(6) 3.67	(14) 3.83	(17) 3.94	(26) 4.04
14	Canada	3.87	(13) 3.71	(11) 4.03	(32) 3.24	(8) 3.99	(15) 4.01	(5) 4.41
15	United States	3.86	(15) 3.68	(7) 4.15	(36) 3.21	(11) 3.92	(5) 4.17	(16) 4.19
16	Denmark	3.85	(19) 3.58	(15) 3.99	(16) 3.46	(15) 3.83	(18) 3.94	(7) 4.38
17	France	3.84	(17) 3.63	(14) 4.00	(28) 3.30	(12) 3.87	(14) 4.01	(9) 4.37
18	Australia	3.84	(14) 3.68	(18) 3.78	(3) 3.78	(17) 3.77	(20) 3.87	(18) 4.16
19	Austria	3.76	(20) 3.49	(21) 3.68	(4) 3.78	(20) 3.70	(22) 3.83	(23) 4.08
20	Taiwan	3.71	(25) 3.35	(22) 3.62	(10) 3.64	(22) 3.65	(12) 4.04	(30) 3.95

Source: Arvis et al., 2010

Canada ranks 14th with a composite index of 3.87, just ahead of the United States. In 2007, Canada was in 10th place with a 3.92 index and a confidence interval of ± 0.05, which means that there is not really any significant statistical difference between Canada's performance in 2007 and in 2010. In fact, it is risky

to compare the two classifications, since the definition of criteria chosen was changed in 2010. In 2007, the United States was in 14th place with an index of 3.84 and a confidence interval of ± 0.03.

Closer examination of Canada's performance based on the six criteria used reveals that the third, "ease of arranging competitively priced shipments," is the greatest hindrance to Canada's performance. Canada ranks 32nd for this criterion. To gain a clearer understanding of Canada's results, we requested and obtained more specific information from the World Bank concerning the source of the assessments used. We learned that Canada's performance was assessed by 69 respondents, particularly freight forwarders, located in the United States (32%), Mexico (15%) and Peru (9%). The remaining respondents were from Asia (10%), South America (7%), Central America (4%), etc. Major companies such as UPS, Panalpina, Kuehne + Nagel, DHL and Damco account for close to half of the respondents for Canada, and the rest were smaller companies.

We discovered that the respondents based in Mexico—a NAFTA member country and one of Canada's major trading partners—were somewhat hard on Canada for the criterion "ease of arranging international competitively priced shipments to Canada," assigning a score far below the average, while US-based respondents provided a much more positive assessment. Considering that the respondents based in Peru also gave Canada lower-than-average scores, nearly 25% of respondents are dissatisfied with regard to this criterion. These results confirm the opinions expressed by managers of Canadian companies based in Mexico who report difficulties in shipping their products to Canada. At the same time, it is important not to read too much into this criterion, since developed countries such as the United States appear to be experiencing similar problems.

There are no big surprises in terms of the top-ranked countries. In fact, countries such as Germany and Singapore have policies and master plans for developing their international logistics infrastructures and competencies. Also, it is interesting to note that the top six countries rank first or second for at least one of the six criteria used.

In its 2010 report, the World Bank demonstrates the connection between logistics performance and international trade. For example, a study by Hoekman and Nicita (2008) demonstrates that a high Logistics Performance Index (LPI) is closely associated with bilateral trade growth. A connection is also established between the high LPI index and the market share for parts and components in a country's exports. This reflects the importance of logistics in managing and integrating global production networks. Last, reference is made to other studies that tend to demonstrate the obvious: that good logistics performance is a necessary condition for facilitating international trade.

In conclusion, it is interesting to note that, with the exception of Japan, all of the countries ranked higher than Canada in Table 1 also best Canada in OECD country rankings for labour productivity. In short, Canada would be well-advised to continue developing its logistics competencies, performance and infrastructure in order to facilitate the growth of international trade, productivity and the economy. We will come back to this topic in Section 5 with suggestions for ways to improve, particularly in terms of customs formalities and transportation infrastructure.

2. Supply chain management and business productivity

Is there a connection between supply chain management good practices and business productivity? To answer this question, we analyzed the results of several empirical studies (Beaulieu and Roy, 2009). Based on this analysis, we made the following observations:

- Good logistics practices have a positive effect on operational business performance (speed of delivery, responsiveness, flexibility and delivery capacity) and on their trade performance (average growth of the market share, average growth in sales volume and average growth of sales in dollars). These results come from a survey of the American manufacturing sector with a sample of 142 respondents from organizations with over 500 employees (Green et al., 2008).
- Using good logistics practices (integration, outsourcing and client service) and deploying logistics competencies (quality and services, operations and distribution, and design efficiency) would have a positive effect on companies' organizational performance, particularly in terms of their competitiveness. This survey was conducted among about 100 manufacturing companies in the United States and Taiwan (Chow et al., 2008).
- Establishing quality management practices with suppliers strengthens their involvement and cooperation, which in turn improves organizational performance. These results come from a study of 103 local companies in Hong Kong and Taiwan (Lin et al., 2005).
- Last, strategic logistics management, supported by quality improvement efforts, positively affects service performance indicators (speed, reliability, turnaround time and inventory turnover) and operational efficiency (operational costs), expressed in greater client satisfaction and better business performance (market share, sales volume and profitability). The data come from 225 respondents in Hong Kong (though 75% of them have their head office in the United States), Japan, the Netherlands and other countries (Yeung, 2008).

Generally speaking, good practices should lead to better performance. However, these best practices must be associated with a specific context and carried out from a holistic perspective. Table 2, from a study by Laugen et al (2005), tends to confirm the effect of introducing best practices to business performance.

Table 2: Exemplary logistics and performance management

	Companies with an excellent supply chain	Companies with a less effective supply chain	All respondents
Delivery time for an order	15 days	21 days	20 days
Rate of on-time delivery	95%	90%	93%
Financial cycle	60 days	95 days	70 days
Annual inventory turnover rate	10 turns	6 turns	8 turns
Length of new product development cycle	180 days	340 days	180 days

Source: Laugen et al. (2005)

These studies demonstrate that logistics practices have a positive effect on the operational performance of companies. However, the impact on the organization's financial performance would be more indirect. One of the few studies that establish a direct link is the survey by D'Avanzo et al. (2003) of 636 of the top 3,000 international companies. This study reveals that 90% of respondents consider supply chain management a critical aspect of an organization's performance. The authors suggest a very strong direct link between supply chain management and financial performance. Other surveys reveal that companies with more mature logistical practices are 40% more profitable than manufacturing companies whose practices are not as highly developed (Beaulieu and Roy, 2009).

Moreover, beyond its positive impact on companies' operational and financial performance, there is increasing recognition that supply chain management also constitutes a key source of competitive advantage for organizations that excel in their business line. Examples in this regard include internationally known companies such as Wal-Mart, Dell and Zara, whose success is essentially based on a forward-thinking logistics strategy. In Canada, companies such as L'Oréal Canada, Uni-Select and Groupe Dynamite also stand out for their innovative logistics practices in their respective markets.

3. Comparative analysis of the logistics performance of Canadian and American companies

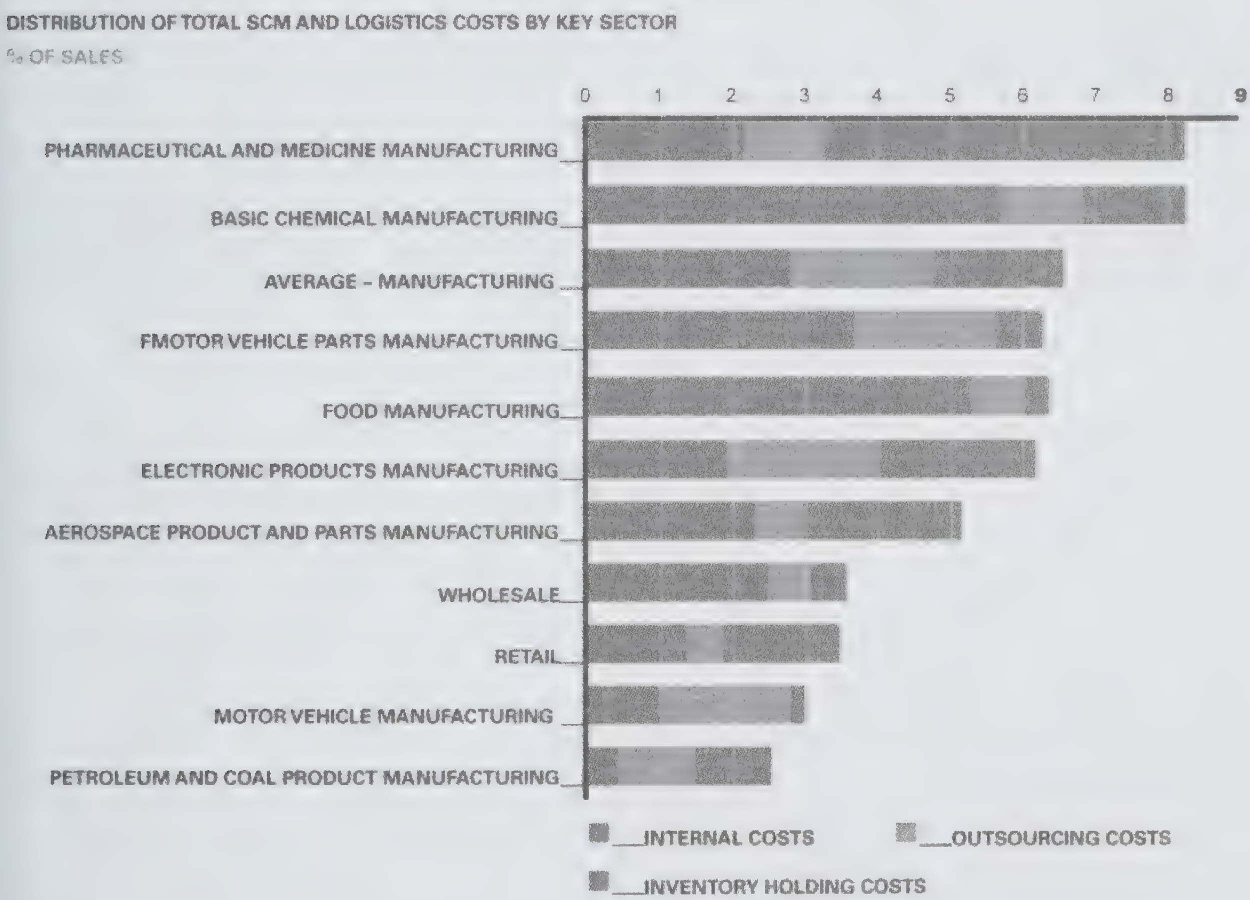
In Section 1, we saw that Canada ranked 14th in the World Bank classification based on the international Logistics Performance Index classification, just ahead of the United States. In the preceding section, we demonstrated the effect of good logistics practices on operational and general business performance. This section answers the question of how the performance

of Canadian companies compares with that of American companies in terms of the main key logistics indicators.

We will look first at the total costs of logistics and supply chain management activities. These costs can be divided into three categories: 1) internal costs, that is, those associated with logistics activities conducted within the company, 2) the cost of logistics activities outsourced to external service providers such as transportation and warehousing, and 3) inventory holding costs such as financing, obsolescence and breakage (Industry Canada, 2008). Figure 1 illustrates the distribution of total supply chain management costs expressed in sales percentages for Canada's main key sectors in 2008.

It can be seen that logistics and supply chain management costs are higher in the manufacturing sector than in the wholesale and retail sectors. Moreover, logistics costs vary widely from one subsector to another. For example, they are higher for the pharmaceutical products subsector than for the motor vehicle subsector.

Figure 1: Distribution of Canada's supply chain total costs in 2008



Source: Industry Canada (2008)

Table 2 compares the costs of supply chain management in Canada and the United States by sector and cost category. In all sectors, the costs observed in the United States are lower than costs in Canada. More specifically, Canada's logistics costs are 12.5% higher than US costs in the manufacturing sector, 18% higher among wholesalers and 29.6% higher among retailers. It is understandable that costs would be higher for Canadian wholesalers and retailers because of the smaller market and the physical size of the country from coast to coast. That said,

these gaps are significant and reflect to some extent the gap referred to in the introduction in work productivity between the two countries. This is especially true for manufacturing companies that compete in the same North American market as their neighbours to the south. The percentages presented in Table 2 may appear low, but it is important to bear in mind that total logistics costs in the United States in 2008 were US$1.344 billion, which accounted for 9.4% of the country's GDP for that year (Wilson, 2009).

Table 2: Supply Chain Management Costs in Canada and the United States

(% of Sales, 2008)

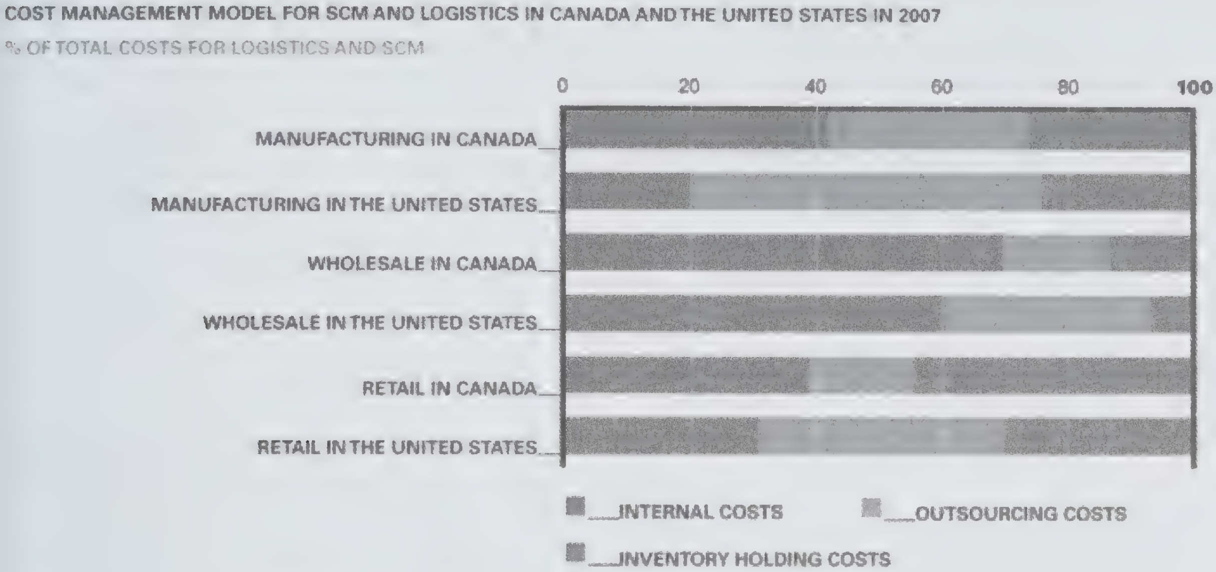
	Canada			United States		
Costs	Manu-facturing	Wholesale	Retail	Manu-facturing	Wholesale	Retail
Internal	2.68%	2.45%	1.22%	1.20%	1.90%	0.80%
Out-sourced	2.10%	0.59%	0.65%	3.20%	0.90%	1.00%
Holding	1.71%	0.50%	1.50%	1.37%	0.20%	0.80%
Totals	6.49%	3.54%	3.37%	5.77%	3.00%	2.60%

Source: Industry Canada (2008)

Closer examination of Table 2 reveals that American companies have lower inventory holding costs than their Canadian counterparts in all sectors of the economy. The reason for this is higher inventory turnover rates than in Canada, one of the most well-used indicators for assessing the industry's agility. In the manufacturing sector, then, just-in-time practices result in high turnover rates for raw materials and other upstream components. The turnover rate observed in the American manufacturing sector is 24% higher than the rate for that sector in Canada. In the distribution sectors (wholesale and retail), there is an increasing effort to supply retailers just in time in order to reduce unsold inventories and provide product assortments that correspond more closely with demand. Here, too, inventory turnover rates observed in the United States are higher by 10% and 29% respectively in the wholesale and retail sectors (Industry Canada, 2008).

Table 2 also indicates that the costs of activities outsourced to logistics service providers are higher in the United States than in Canada. This is expressed in a worldwide trend whereby logistics activities are increasingly being handled by specialists referred to as "3PL," which stands for "third-party logistics providers." The main reason companies outsource logistics services is to save money. It is therefore not surprising to note that the total cost of logistics is relatively lower in the United States than in Canada, partly because of the higher use of outsourcing, as shown in Figure 2.

Figure 2: Distribution of logistics costs in Canada and the United States



Source: Industry Canada (2008)

4. Innovation in the supply chain for Canadian companies

In Section 2, we demonstrated that companies that have adopted best or innovative practices for supply chain management enjoy a higher organizational performance level than other companies. We will now examine the nature of these practices and then determine, where applicable, the extent to which Canadian companies use such practices.

4.1 Supply chain management best practices

A number of authors have proposed lists of supply chain management best practices. Our objective is not to produce an exhaustive list of all of these nomenclatures, but rather to provide an overview of the main practices that in our opinion have garnered fairly broad consensus.

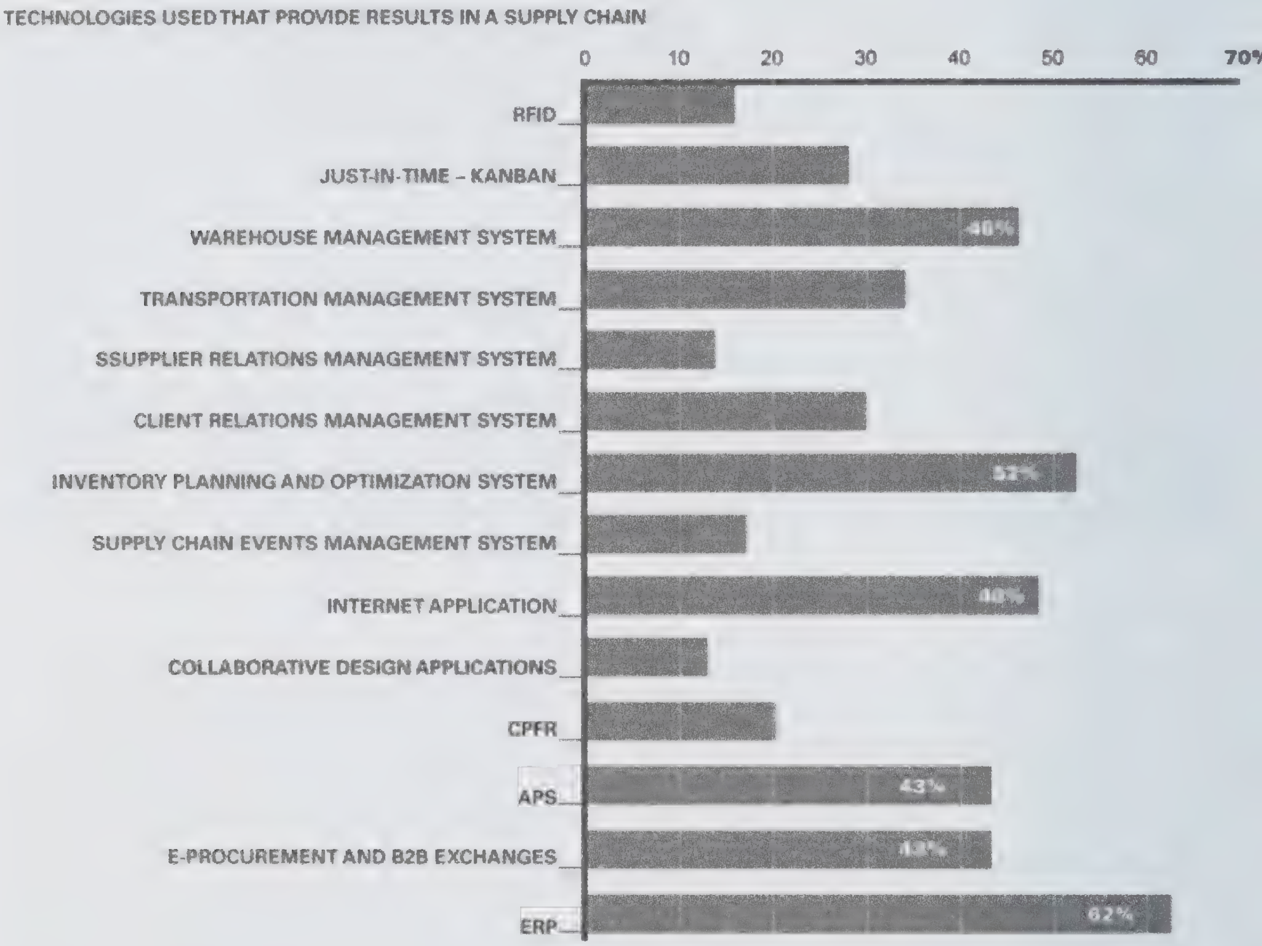
1) The use of information and communication technologies

To properly manage the supply chain, companies must adopt new information and communication technologies to facilitate the integration of upstream and downstream activities and enable the various stakeholders in the chain to collaborate among themselves. These technologies include information systems such as integrated business management systems (enterprise resource planning – ERP), warehouse management systems (WMS) and transportation management systems (TMS). Other communication technologies referred to are on-board computers, global positioning systems (GPS) and radio frequency identification tags (RFID). By extension, these practices also include all optimization software designed to develop the best delivery routes, better manage inventories and obtain the optimal configuration of a logistics network including the number and location of production and distribution units, and to perform other tasks. In short, the use of technology provides greater visibility for products

along the chain and offers partners greater connectivity, which in turn facilitates cooperation and integration.

Figure 3 presents the results of a survey by Poirier and Quinn (2006) among supply chain management professionals in North America, Europe and Australia (120 respondents). The survey indicates the percentage of respondents using one of these technologies. It reveals that 14% of respondents would adopt all of these technologies, and that of the five most popular technological applications (actually six, since two are tied), four involve technologies with internal applications for an organization (ERP, inventory planning and optimization system, WMS and APS).

Figure 3: Use of various supply chain management technologies



Source: Poirier and Quinn (2006)

2) Cooperation between supply chain partners

Over the last decade, the just-in-time philosophy was adapted to the distribution of finished goods from factory to sales outlets and distribution centres. This has given rise to continuous replenishment practices known as Quick Response (QR) or Efficient Consumer Response (ECR), and more recently, to collaborative planning, forecasting and replenishment (CPFR) over the Internet. Essentially, these practices facilitate partnerships between members of a distribution network to better plan replenishment of finished goods for retailers on the basis of information coming from the sales outlets as well as from collaborative forecasting among network members. This approach differs from

the traditional replenishment method based almost exclusively on the independent processing of orders received at each level of the network.

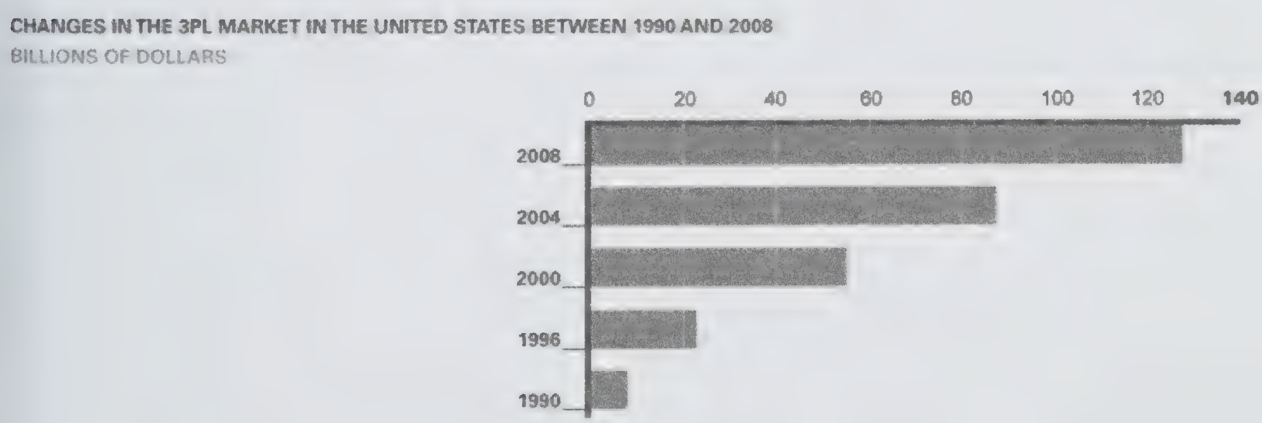
A recent technological innovation, flowcasting, sets forth the idea of an information system through which a database can be developed that is shared by the various stakeholders in a supply chain. The system is based on a single set of forecasts, made at sales outlets, to plan replenishment of retail stores and distribution centres. Tests were performed in the United States between a large retailer and a major food product supplier, and the results are extremely interesting: there was a significant reduction in the inventory level and an increase in the level of service and rate of coverage of in-store products. (Beaulieu and Roy, 2009).

3) Outsourcing of logistics services

With globalization and market liberalization, companies are increasingly looking to focus on activities in which they excel, be it motor vehicle assembly or product marketing. In many cases, however, these activities exclude product supply and distribution, which is outsourced to companies specializing in logistics, better known as 3PLs (third party logistics providers). These companies handle some or all of their clients' logistics activities: transportation, warehousing, handling, order processing and preparation, inventory management, supply, distribution, etc.

These logistics service providers have developed rapidly over the past decade and continue to increase steadily. Figure 4 illustrates this trend by showing how the 3PL market in the United States has grown over nearly 20 years, whereas Figure 2 demonstrates that Canadian companies were less likely to outsource their logistics activities to 3PLs. As a result, the Canadian logistics services industry grew by 47% between 1998 and 2007, according to Industry Canada (2008). Still, it is difficult to compare this figure with the American percentage, because the Canadian definition includes transportation service providers. Even so, it is interesting to note that the GDP for Canadian logistics service providers should increase by 40% between 2007 and 2015 to C$56 billion, according to Industry Canada (2008), a rising trend similar to that observed in the United States.

Figure 4: Changes in the 3PL market in the United States between 1990 and 2008



Sources: Chow and Gritta (2002) and Wilson (2009)

4) Approaches for measuring and improving performance

Operational excellence is based on a performance management approach that includes process mapping and improvement, performance measurement using key indicators often grouped into management dashboards, activity based costing, and comparative analysis, better known as benchmarking. Though this performance management approach is not specific to supply chain management, it is still recognized as a necessary condition and best practice. In fact, companies that use key performance indicators report better logistics performance than those that do not (Industry Canada, 2006).

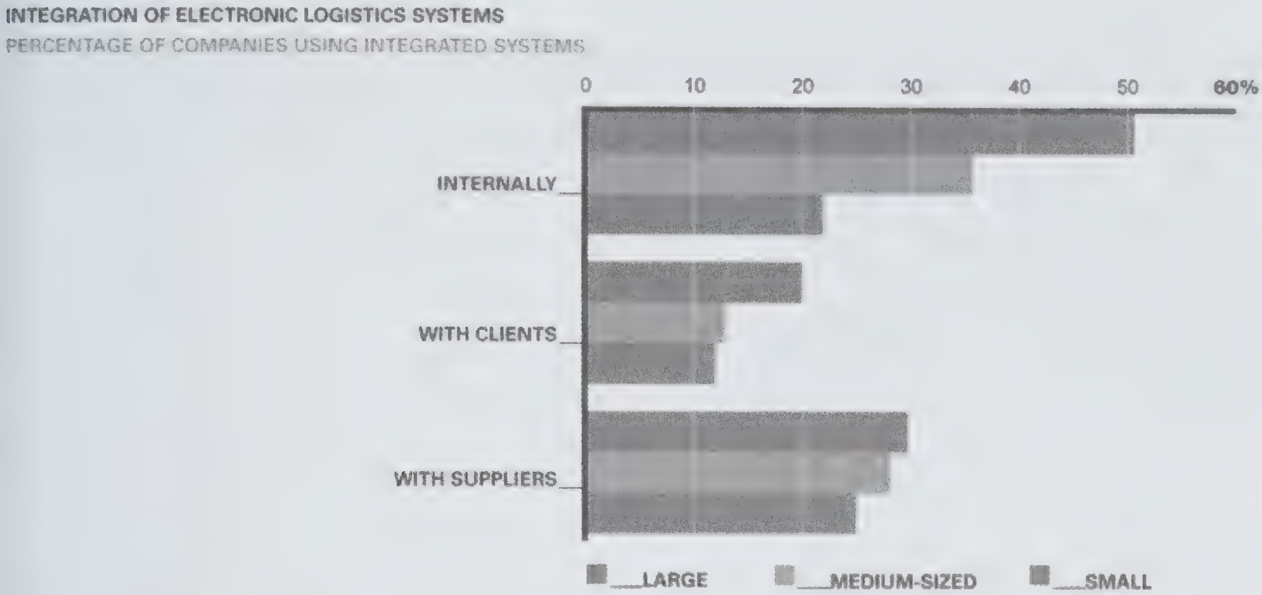
4.2 Use of electronic systems linked to logistics in Canada

In Canada, there has been a relatively low rate of adoption of electronic information systems to manage logistics functions, with use at slightly over 20% by medium-sized and large companies, and a mere 10% by small companies. In the United States, the rate of use is 30% higher than in Canada, regardless of the size of the company (Industry Canada, 2010a). Though use remains low for all sectors, wholesalers boast the highest rate, with 35% adopting electronic logistics management systems. Moreover, retailers and wholesalers are relatively more inclined to use electronic systems to coordinate replenishment activities with their suppliers such as CPFR. This does not prevent manufacturers from increasingly adopting collaborative approaches such as CPFR with their own suppliers.

Last, we know how important it is to integrate electronic information systems to achieve excellence in managing supply chains. Barely half of Canada's major companies have succeeded in integrating electronic supply management systems with their other internal systems as indicated in Figure 5. Naturally, this percentage decreases inversely with the size of the companies. Also, the degree of integration with client and supplier systems is a key indicator of business performance in terms of collaboration and exemplary management of the supply chain. However, relatively few companies have reached this degree of integration with their suppliers. Retailers have achieved the highest adoption rate (close to 40%), which is a result of their efforts in terms of collaborative planning, forecasting and replenishment, or CPFR (Industry Canada, 2010a).

Few surveys have been done to assess the degree to which Canadian companies have adopted logistics practices. One of the most exhaustive such survey was conducted in 2001 in Quebec and was based on a sample of 668 respondents (Roy et al., 2002). The results are presented in Table 3.

Figure 5: Integration of electronic logistics systems



Source: Industry Canada (2010a)

These results indicate that for all of the statements in Table 3 (except for the choice of suppliers on the Internet), deployment is based on the size of the respondents, with the large companies systematically adopting practices and technologies in greater numbers than the small and medium-sized companies. Care should be taken in interpreting these results today, since the survey is several years old and the portrait is bound to have changed, even simply on the basis of new perspectives or technologies such as RFID.

Canadian companies would be well-advised to make a greater effort to adopt and integrate electronic management software. By doing so, they could catch up with their American counterparts, enjoy substantial savings in terms of logistics costs and improve the quality of client services to give them an advantage over their competitors. In fact, adopting supply chain management best practices is not just a matter of saving money, but also—and most importantly—it is a way to obtain a lasting competitive edge.

Table 3: Adoption of Logistics Practices by Quebec Companies
(In Percentages)

Logistics practices	Companies		
	Small	Medium-sized	Large
Inventory management by the supplier	30.0	38.0	43.8
Management of your clients' inventory (VMI)	29.6	31.1	40.0
Alliances or partnerships with transportation or logistics companies	28.0	48.5	60.4
Alliances or partnerships with suppliers (other than transportation or logistics)	44.5	57.2	72.5
Establishment of quality standards (ISO or others)	45.5	52.0	75.0
Use of bar code and optical scanning systems	25.1	48.8	70.0
Training of teams of employees with clients or suppliers	29.5	39.1	46.2
Development or re-engineering of processes with clients or suppliers	26.9	38.9	51.6
Just in time	45.7	55.0	62.9
Forecast sharing with clients and suppliers (CPFR)	34.2	44.8	59.9
Tracking system or logistics performance dashboard	25.6	31.3	61.6
Choice of suppliers on the Internet	25.1	23.9	31.9
Electronic product catalogue	28.2	40.1	52.5
Continuous replenishment method (ECR, *Quick Response*)	12.3	19.8	35.2
Sharing of information gathered at sales outlets	25.9	44.9	47.5

Source: Roy et al. (2002)

4.3 Outsourcing to countries with low production costs

Market globalization and increased international competition is prompting companies to focus increasingly on competencies in which they excel, and consequently, to outsource to third parties the activities at which they are less adept or for which emerging countries have a significant competitive cost advantage. China is obviously central to this phenomenon by reason of its size and very high and sustained growth rate. In 2007, 90% of Canadian manufacturers

outsourced to China (Industry Canada, 2007). Foreign subsidiaries of multinationals in China account for over a quarter of that country's industrial production and 58% of Chinese exports and provide jobs for over 10 million people (Sydor, 2006). However, offshoring production activities also benefits other Asian countries and growth is being observed in emerging countries in Central and South America as well as in Eastern Europe.

In Canada, this phenomenon certainly affects companies working in traditional sectors such as clothing (Gildan) and furniture (Shermag), but the same trend can be seen in hi-tech sectors such as aeronautics. In fact, Pratt& Whitney Canada has production activities in Poland and Bombardier Aerospace manufactures electrical harnesses and other components in Mexico and China.

There are numerous consequences of this globalization of supply sources (global sourcing). First, companies obviously enjoy the advantages associated with lower production costs, which unfortunately come with ever-increasing transportation costs and the need to maintain more inventories locally to ensure the continuity of their operations during the supply period, and this in turn generates increased warehousing and inventory holding costs. In some cases, more rapid transportation methods such as air transport are preferred, rather than the slower method of shipping by sea, but there again, this increases transportation costs significantly. According to Industry Canada (2007), the time frame for outsourcing products to China varies from a minimum of one to three months, to a maximum of three to six months.

There are other consequences of this phenomenon such as additional delays owing to port congestion and capacity problems experienced by foreign suppliers as their popularity increases. Other challenges are errors in the orders received and problems with the quality of the products delivered. Avoiding these risks often means increasing the level of inventory kept locally or setting up alternative supply sources, which increases complexity and operating costs.

The 1990s brought predictions that conventional distribution centres would disappear because of the increasing popularity of cross-docking centres. Today, the use of outsourcing to countries with low production costs makes it necessary to keep more inventories locally and the number of distribution centres is virtually exploding. In fact, investment in new distribution centres rose by 60% between 2001 and 2007 (Industry Canada, 2007). Examples of such centres are the new facilities of The Aldo Group, The Hockey Company, Alimentation Couche-Tard and Canadian Tire, and these are just the ones in Greater Montreal.

Again, according to Industry Canada (2007), barely 43% of Canadian companies that chose to outsource to countries with low production costs reported that they had successfully lowered the total delivered cost of their products as a result. To achieve this result, these companies adopted a number of best practices, presented in Table 4.

Table 4: Practical examples of companies that decreased their total delivered cost

Practice	Percentage of Companies Adopting Best Practices
Analysis of total logistics cost	84%
Allocation of dedicated human resources	79%
Establishment of secondary supply sources	79%
Use of air transportation	76%
Training of suppliers from low-cost countries	70%
Adding supplementary inventory	21%

Source: Industry Canada (2007)

First, the companies that succeed are the ones that know their costs. This may seem obvious, but many companies decide to outsource to low-cost countries solely on the basis of anticipated savings in labour costs. A good analysis of the total delivered cost can sometimes reveal surprises to companies that have underestimated factors such as increases in the cost of transportation, warehousing and poor quality, to name but a few.

Allocating dedicated resources to global sourcing and sending company staff to work onsite in a low-cost country are ways of ensuring the success of the operation, as doing so will mean, for example, that foreign suppliers are better trained. Despite these measures, there will be unexpected and emergency situations. In such cases, successful companies do not hesitate to use air transport and secondary supply sources in less risky countries. Although the company incurs additional costs, it avoids having to keep too much inventory on hand, which successful companies are reluctant to do. However, it is interesting to note that setting up supplementary inventory is a widespread practice in 85% of the companies whose total cost increased after they outsourced to low-cost countries.

4.4 Green logistics

There is increasing concern over environmental and sustainable development issues in our society. The transportation sector alone generated some 27% of greenhouse gas emissions (GGEs) in Canada in 2007 (Transport Canada, 2009). Logistics can therefore foster sustainable development through the design of supply chains that reduce transportation needs. We might also add that it is also advantageous for companies to create an environmentally friendly "green" image. This pressure can sometimes come in the form of a requirement to obtain environmental certification, such as the ISO 14,000 standard, to comply with the

requirements of certain clients or orderers. Also promoted is the green logistics concept, which is essentially aimed at reducing the harmful effects of logistics-related activities, such as hard-to-recycle packaging and air pollution.

In Canada, a recent study reveals that manufacturers who adopt green logistics practices report improvements that reduce energy consumption, GGEs, packaging and waste (Industry Canada, 2009). The study also reports that 80% of the highest-performing green logistics manufacturers observed a reduction of their distribution costs and a more loyal clientele. Moreover, 90% of these manufacturers reported improvements in their compliance processes. Other business advantages observed by these high-performing companies in terms of green logistics were improved risk management, greater access to foreign markets, increased sales and greater differentiation in distribution services (Industry Canada, 2009). In short, green logistics represents another opportunity for Canadian companies to improve their performance and make their mark in international markets.

5. Conclusion and government policy implications

5.1 Conclusion

In this chapter, we saw that Canada lagged behind other OECD member countries in terms of per capita GDP and labour productivity levels. The vast majority of countries that are doing better than Canada in this regard also perform better when it comes to supply chain management, both internationally and at the company level. Canada ranks 14th on the World Bank's international logistics performance index. Performance could be improved by addressing customs formalities, transportation infrastructure, and especially "ease of arranging competitively priced shipments," for which Canada ranks 32nd.

Generally speaking, it has been demonstrated that for companies, good logistics practices foster better organizational performance. We compared the performance of Canadian and American companies on the basis of logistics costs. Such costs for the Canadian companies were 12.5% higher in the manufacturing sector, 18% higher for wholesalers and 29.6% higher for retailers. To gain a better understanding of these differences, we identified the main best logistics practices adopted by companies known for their superior performance. It was demonstrated that 1) the rate of use of electronic systems for logistics was 30% higher for American companies than for Canadian companies; 2) American companies outsourced logistics activities to designated 3PL service providers much more than Canadian companies did; 3) the integration of electronic logistical systems was incomplete, especially in the case of SMEs; and 4) most companies outsourcing to low cost countries did not adopt best practices in this regard.

5.2 Implications for government policy

We will now examine the implications of these results on possible government policy or action by separating the more global issues from those more specifically affecting Canadian companies.

5.2.1 *Global issues*

Because Germany ranks first on the World Bank's Logistics Performance Index, it is a good idea to try to understand the reasons for its high performance. This country leads in infrastructure and ranks third for customs formalities, two criteria for which there is government involvement. The German government takes an active interest in logistics and has developed a master plan for freight transport and logistics (Tiedemann, 2009). The objectives of this plan are as follows:

- Optimize the use of infrastructure and make transportation more efficient;
- Eliminate unnecessary travel to facilitate mobility;
- Move more traffic to domestic rail and maritime routes;
- Promote clean, green transportation;
- Create good working conditions and training in the freight industry;
- Adopt measures to make Germany even more attractive as a logistics centre.

Canada's challenges are very similar to those facing Germany (globalization and global sourcing, increase in traffic and congestion, labour shortages, environmental protection and new logistics technologies). Canada could draw on the objectives and measures proposed in Germany's master plan. For example, to attract the flow of goods to or from North America through Canada, it would be helpful to align government policy with the environmental and technological logistics mandates of multinationals. To achieve this, the Canadian government could try to attract investment in logistics to Canada by facilitating the emergence of logistics centres like those in countries that have received high ratings from the World Bank. Another example from the Throne Speech and the 2010 budget is that the government has promised to develop a strategy to make Canada a leader in the global digital economy. Innovation in global supply chain management could be a pillar of this strategy.

Benchmarking is good practice in logistics, and, more generally, in management. The Canadian government should also practice benchmarking by analyzing the high logistics performance of countries such as Germany. In developing its master plan, the German government conducted numerous consultations with representatives from industry, academia, professional associations, unions, etc. In Canada, there is a similar initiative—Gateways and Trade Corridors—in Western, Central and Eastern Canada. In this context, it is helpful to take a look at some of the recommendations that came out of a workshop held at the University of Western Ontario in March 2008 concerning the Ontario-Quebec Continental Gateway and Trade Corridor (Cunningham, 2008).

- With regard to Canada's competitiveness in North America, recommendations included 1) setting up an agency that would coordinate policy through a number of jurisdictions, both within Canada and with the United States; 2) strengthening the free trade agreement with the United States to increase the flow of goods, services and capital; and 3) considering the concept of free trade zones like in Rotterdam, Netherlands.

- In terms of border-related issues, one of the criteria of the World Bank index, it was suggested that the focus should be on border congestion problems, identifying bottlenecks and investing in reducing them. Another suggestion was to expand the security perimeter to include the entire continent and not just to limit it to the borders. Last, it was suggested that customs formalities with Mexico and the United States be simplified. This last recommendation lines up with the concerns of freight agents that expressed their dissatisfaction with international shipments to Canada. This is consistent with the advice of numerous other experts in Canada who feel that Canada could play a bigger role as a continental port of entry and take advantage of NAFTA if the border-related issues could be mitigated and the regulations for various methods of transportation harmonized (see for example Brooks, 2006).
- In terms of infrastructure, another World Bank criterion, the report recommended adopting a continental approach for planning transportation systems and infrastructure. In fact, it is felt that road, rail, air and sea transportation corridors must be planned at the continental level to determine the extent and levels of current and future congestion. In particular, rail transportation requires consideration, given the growing need, particularly as a result of environmental pressures that are expected to further increase its popularity.
- Last, other relevant recommendations concerned issues such as harmonizing road transportation regulations between provinces, adopting an intelligent transportation systems policy and developing technologies to facilitate transportation and customs procedures and greater availability of statistical data on the flow of goods.

5.2.2 Company-related issues

Government policy would also be relevant with regard to companies. First, despite recent efforts by Industry Canada to better understand and support Canada's logistics sector, much remains to be done in terms of assessing and understanding the performance level of Canadian companies regarding supply chain management. Recent Industry Canada studies and surveys show that Canadian companies are lagging when it comes to deploying and integrating electronic systems for logistics and outsourcing. It also reveals that most companies that outsource to low-cost countries do not adopt best practices, and their total cost results are therefore negative.

That said, we do not know why Canadian companies lag behind in adopting better practices. Are they less well informed? Are their managers less well trained? Do they have the financial means for adopting and integrating the increasingly sophisticated systems being promoted in supply chain management? Are there concrete examples of companies that have successfully adopted best practices in terms of logistics and demonstrated leadership in their business line? How should this knowledge and these good practices be conveyed to companies that are having more difficulty? Should smaller companies that are taking longer to adopt best practices receive assistance? Does government policy on innovation also cover logistics issues? These are issues that call for some level of government involvement.

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The Role of Global Value Chains for German Manufacturing

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Introduction

Since the 1960s, Germany has established itself as European manufacturing centre, and its export of goods *made in Germany* has become a pillar of its economic post-war success. In recent years, many German firms have further deepened their international involvements with links to global value chains. Lower costs of doing business internationally and increasing possibilities to source material and service inputs in multiple countries have triggered new forms of organizational adjustments. Such novel types of adjustment faced by firms have, in turn, further pushed the issue of global value chains to the forefront of the policy and academic debate, and have often been surrounded by public fear about job losses and foreign competition.

This paper investigates the role of global value chains in the organization of Germany´s manufacturing activities and its recent economic developments. In particular it asks: how important are global value chains for German manufacturing firms? Why do firms use global value chains? What are the implications for Germany of the use of global value chains? The paper measures the extent of Germany's link into global value chains, discusses the causes and consequences of such, and concludes with a brief outlook on the likely future of such international production chains.

German manufacturing: Overview and trends

This section describes Germany's manufacturing sector and compares it with that of other countries. It presents some statistics on the size of the sector, distribution of activities across manufacturing sub-sectors, levels of employment and estimates of productivity. Furthermore, in order to give a first impression of Germany's links into the global economy, we also describe briefly export activity and activity of outward investment by multinationals across broad manufacturing sub-sectors. We will also look at aggregate trade statistics for Germany to gauge the importance and implications of import competition from low-wage countries for German manufacturing industries.

Table 1 shows the prominence of the manufacturing industry for Germany and compares it with a number of other countries. As can be seen, in Germany, manufacturing accounts for about 22 percent of GDP. This is a very high share compared to other industrialized countries such as Canada, the UK, France or the US. It is also higher than

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in the newly industrializing BRIC countries, with one exception. The only country that has a higher, and still growing, manufacturing share is China. Its manufacturing sector accounted for roughly one-third of Chinese economic activity in the last few years. Also, while there has been a downward trend in the share of manufacturing in GDP in most OECD countries, this does not appear to have been the case to the same extent in Germany.[1]

Table 1: Manufacturing value added as percentage of GDP

	2005	2006	2007
Germany	22.5	22.6	..
Canada	16.2	15.5	14.9
China	32.8	33.6	34.1
Brazil	18.1	17.4	17.4
India	15.8	16.3	16.3
Russian Federation	19.0	18.2	19.0
United Kingdom	13.5	..	..
France	13.2	12.7	12.2
United States	14.1	13.9	..

Source: World Bank, World Development Indicators

Table 2 depicts some vital statistics for the German manufacturing industry overall. It shows in the same table the number of firms and employees in all manufacturing sub-sectors. German firms and employees are active within the whole range of manufacturing activities, as expected from an economy of the size of Germany. In 2007, there were roughly 37,000 manufacturing firms which employed about 6.2 million employees. By far the largest sectors in terms of employment are "Machinery" and "Motor Vehicles", the two German flagship manufacturing sectors. These two sectors alone account for about 30 percent of employment in all manufacturing industries.

The "Machinery" sector is not only a key industry in terms of employment, but is also important in terms of actual firm numbers. Other sectors that boast substantial numbers of firms are "Fabricated Metals" and "Food & Beverages", but these employ relatively fewer workers. This is best reflected in the average number of employees per firm, which is quite low in these three sectors compared to "Motor Vehicles". It points to the importance of the German small and medium sized firms, also known as the *"Mittelstand"*, within the spectrum of German firms. These are often small firms (less than 1000 employees), family owned and active in the German manufacturing sector. These firms are often described as being at the core of German industrial structure and behind the export success of Germany.

[1] One argument why Germany keeps this current constellation and the resulting stable share of manufacturing in value added is that German firms produce highly sophisticated goods less inclined to foreign competition from emerging countries. Figure 1 below shows that highly skilled industries (with high wage rates) are less exposed to foreign competition from low-wage countries.

Table 2: Activities by manufacturing sub-sector, 2007

		firms	employment	employment per firm	net value added	annual wage per employee	value added per worker
		#	#	#	thousand euros	thousand euros	thousand euros
2007							
15	Food & Beverages	5 040	617 614	123	25 517 535	30.57	41.32
16	Tobacco	24	11 592	483	1 196 012	65.72	103.18
17	Textiles	766	81 467	106	3 613 428	36.41	44.35
18	Wearing apparel	340	39 484	116	2 144 891	36.80	54.32
19	Leather	164	16 256	99	667 137	32.74	41.04
20	Wood	989	83 031	84	3 890 241	37.36	46.85
21	Paper	816	137 730	169	8 069 339	45.71	58.59
22	Publishing & Printing	2 376	284 365	120	13 957 954	38.46	49.08
23	Coke & petroleum	47	20 221	430	3 552 444	88.10	175.68
24	Chemicals	1 411	440 846	312	42 777 215	65.08	97.03
25	Rubber	2 632	355 877	135	18 420 174	41.00	51.76
26	Non-metallic minerals	1 509	195 926	130	11 077 309	43.68	56.54
27	Basic Metals	902	252 828	280	21 501 929	54.49	85.05
28	Fabricated Metals	6 252	608 756	97	31 933 115	41.80	52.46
29	Machinery	6 042	997 246	165	67 875 414	53.51	68.06
30	Office Machinery	159	38 701	243	3 774 406	68.62	97.53
31	Electrical Machinery	1 945	446 217	229	28 584 256	55.99	64.06
32	Radio and Communication	545	145 746	267	10 624 203	66.90	72.90
33	Medical Instruments	2 047	234 159	114	16 088 584	50.47	68.71
34	Motor Vehicles	1 005	837 542	833	61 105 943	64.80	72.96
35	Other Transport Equipment	313	138 778	443	9 899 881	63.73	71.34
36	Miscellaneous	1 449	165 538	114	8 123 040	38.80	49.07
37	Recycling	172	13 607	79	807 903	37.29	59.37
	Total	36 945	6 163 527		395 202 353		

Source: Statistisches Bundesamt

Table 2 also presents some valuable data on average yearly wages and labour productivity (measured as value added per worker) across manufacturing sub-sectors in 2007. While Germany is generally considered to be a high wage country, the statistics show that there is considerable heterogeneity in wages across manufacturing sectors. The average employee in the "Food & Beverages" sector earns, for example, around 30,000 euros per year, compared to 68,000 for an employee in "Office Machinery" or 88,000 in the "Coke & Petroleum" industry. The spread of average labour productivity is equally wide, ranging from 41,000 in "Food & Beverages" to 175,000 in "Coke & Petroleum". "Office Machinery" is also a highly productive industry by this benchmark.

Table 3 dispels the popular myths that all German firms export their goods or source their inputs abroad. The table presents the percentages of firms that export, import, do both or neither of these international trade activities. Actually, the data show that most German firms are not involved in any form of trading activity with foreign associates in 2005 (61 percent).[2] However, among German firms that are trading with foreign partners, most of them import and export simultaneously. Indeed, from 2001 to 2005 the proportion of firms doing so has even increased from 16 to 19 percent. Also, the share of firms that do not engage in any international trade activity has declined by 6 percentage points over the same period. This substantial increase in internationally active firms has also been highlighted by Vogel et al. (2009). It suggests that foreign markets, not only as a source for demand but also for supply of global value chains, have become more important for a wider range of German firms over the last years.

[2] This is not specific to Germany but is mirrored in other countries, see, for example, Bernard et al. (2007) for the US.

Table 3: Export- and import-participation in manufacturing 2001 - 2006

Reporting year	Share (in percent) of firms which...			
	Neither export nor import	Only export	Only import	Export and import
2001	67%	8%	9%	16%
2002	64%	9%	10%	17%
2003	63%	9%	10%	18%
2004	62%	9%	11%	18%
2005	61%	9%	11%	19%

Source: Own calculations based on Vogel et al. (2009)

Table 4 also displays some information about the trading status of German firms, but this time disaggregated by two-digit ISIC manufacturing industry. It shows that different industries face diverse shares of export and import participation of their firms. It ranges from "Food and Beverage" with the highest share of firms that neither export nor import (82 percent), to "Rubber", "Machinery" or "Chemicals" in which the majority of firms have undertaken some international transactions in 2006. A look back to Table 2 also shows that the industries with high export and import activity are also those sectors where the *Mittelstand* is important.

Table 4: Export and Import participation of German firms by 2-digit manufacturing industry, 2006

Industry key	Share of firms which...			
	Neither export nor import	Only export	Only import	Export and import
15 Food and Beverage	82%	3%	9%	6%
16 Tobacco	39%	X	X	41%
17 Textiles	48%	6%	17%	28%
18 Wearing Apparel	51%	4%	19%	25%
19 Leather	50%	5%	21%	24%
20 Wood	70%	7%	13%	10%
21 Paper	38%	10%	11%	41%
22 Publishing and Printing	62%	18%	7%	13%
23 Coke and Petroleum	45%	7%	13%	29%
24 Chemicals	36%	11%	10%	43%
25 Rubber	35%	13%	10%	42%
26 Non-metallic Minerals	57%	6%	24%	14%
27 Basic Metal	52%	10%	10%	43%

Industry key	Share of firms which...			
	Neither export nor import	Only export	Only import	Export and import
28 Fabricated Metal	65%	9%	10%	16%
29 Machinery	41%	11%	11%	37%
30 Office Machinery	62%	11%	9%	18%
31 Electrical Machinery	43%	10%	12%	35%
32 Radio and Communication	47%	9%	10%	34%
33 Medical Instruments	61%	6%	13%	20%
34 Motor Vehicles	48%	9%	12%	31%
35 Other transport Equipment	44%	X	X	30%
36 Miscellaneous	60%	7%	16%	17%
37 Recycling	64%	14%	7%	15%

Source: Own calculations based on Vogel et al. (2009). X means that the information was not disclosed.

After showing export and import activity based on firm level information, we now turn to aggregated trade statistics for Germany to look, firstly, at the main export destinations and, secondly, gauge the importance of import competition from low-wage countries for German manufacturing industries.

Table 5 shows that the destinations of German exports are heavily concentrated: the top ten export destinations account for roughly 60 percent of total exports in 2009. Another interesting fact is that these top destinations are mainly industrialized countries in Europe and the US. There is one important exception, however: China, which receives about 5 percent of German exports. While the growing importance of China for German exports has, to the best of our knowledge not be investigated in detail yet, it may be partly explained by the pattern of German comparative advantage and export specialization, which is mainly in capital-intensive and research-intensive machinery and equipment (Clemens and Schumacher, 2010); goods that are in high demand Chinese manufacturing industry. Furthermore, German export promotion policy may also have played a non-negligible role. The German government provides an export guarantee scheme which compensates for possible non-payment for the export good by the foreign customer. This guarantee scheme has been in high demand recently, in particular for exports to South Korea, the US and China.[3]

Table 5: Top 10 Export destinations, 2009

		million euros	percent of total exports
1	France	81941	10.1
2	Netherlands	54142	6.7

[3] See "Bundesbürgschaften: Exporthilfen gefragt wie nie" at http://www.manager-magazin.de/politik/artikel/0,2828,702619,00.html, accessed on 23 August 2010.

3	USA	53834	6.7
4	UK	53156	6.6
5	Italy	51050	6.3
6	Austria	48235	6.0
7	Belgium	42155	5.2
8	China	36459	4.5
9	Switzerland	35323	4.4
10	Poland	31626	3.9
...			
31	Canada	5216	0.6
	Total	808155	100

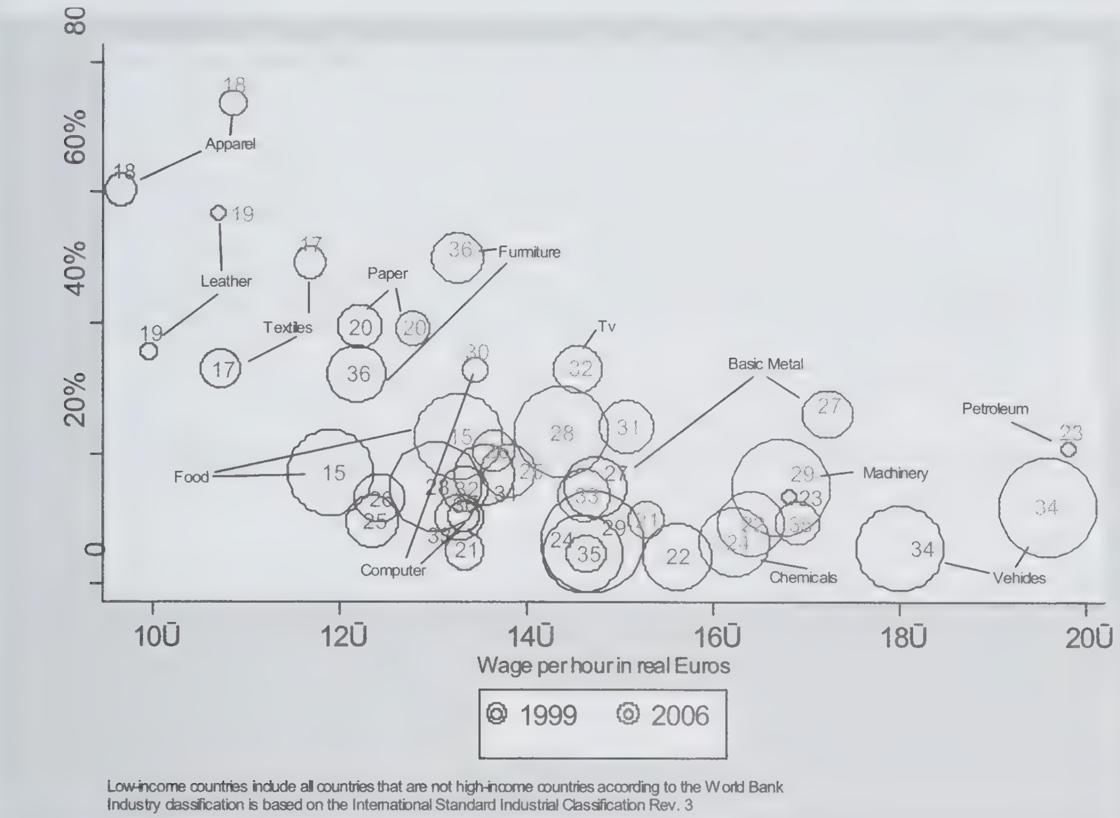
Source: Own calculations based on Statistisches Bundesamt (2010) [Table 5 here]

Turning to imports, Figure 1 illustrates the relationship between hourly wages in 21 German manufacturing industries and competition from low-wage countries in 1999 and 2006. Competition is here defined as the ratio of low-wage country imports to Germany over total German imports. Thus, it includes import of final goods as well as inputs incorporated in this industry classification. The size of the dots represents the relative employment of the respective industries, and the numbers related to each dot correspond to the International Standard Industry Classification (ISIC), Revision 3.

The information in this figure indicates that German manufacturing industries vary substantially in their exposure to competition from low-wage countries. Most noticeable, competition from low-wage countries is concentrated in low-wage industries such as "Wearing Apparel", "Leather" and "Textiles". Meanwhile, large German industries with high wages, such as "Motor Vehicles", "Machinery" and "Equipment" face much less competition from low-wage countries.

Another interesting fact is that such industries like "Televisions and Communication" (32) and "Computers" (30) exhibit intensified competition from low wage countries between 1999 and 2006. Such increased competition is likely to affect indirectly other downstream industries, which might benefit from the arrival on the market of imported goods that they use as inputs but and available at a lower cost.

Figure 1: German exposure to competition from low-wage countries 1999-2006



Sources: Statistisches Bundesamt, own calculations.

This discussion of the current state of German manufacturing then leads to the question as to what role global value chains may have played for the development of the manufacturing sector. This will be the focus of the rest of the paper.

The importance of global value chains

This section deals with measuring the importance of global value chains. While the academic literature on the causes and consequences of offshoring and global value chains (also referred to as vertical disintegration, fragmentation of production, etc.) has grown in recent years (e.g., Arndt and Kierzkowski, 2001; Feenstra and Hanson, 2003; Crino, 2008), it is still fair to say that there is no generally recognized definition of how exactly to measure this phenomenon. We therefore consider a number of important aspects of GVC in order to triangulate the importance thereof.

The first approach to measuring GVC follows the academic literature that attempts to measure the impact of offshoring on labour markets. These studies generally tend to approximate offshoring using industry level data on imported inputs (see, for example, Feenstra and Hanson, 2003, Hijzen et al., 2005, Geishecker and Görg, 2008). Broadly speaking, three main sources have been used to document the trend in international trade in intermediate inputs: data on outward processing trade, trade statistics on trade in intermediate goods, and input-output tables.

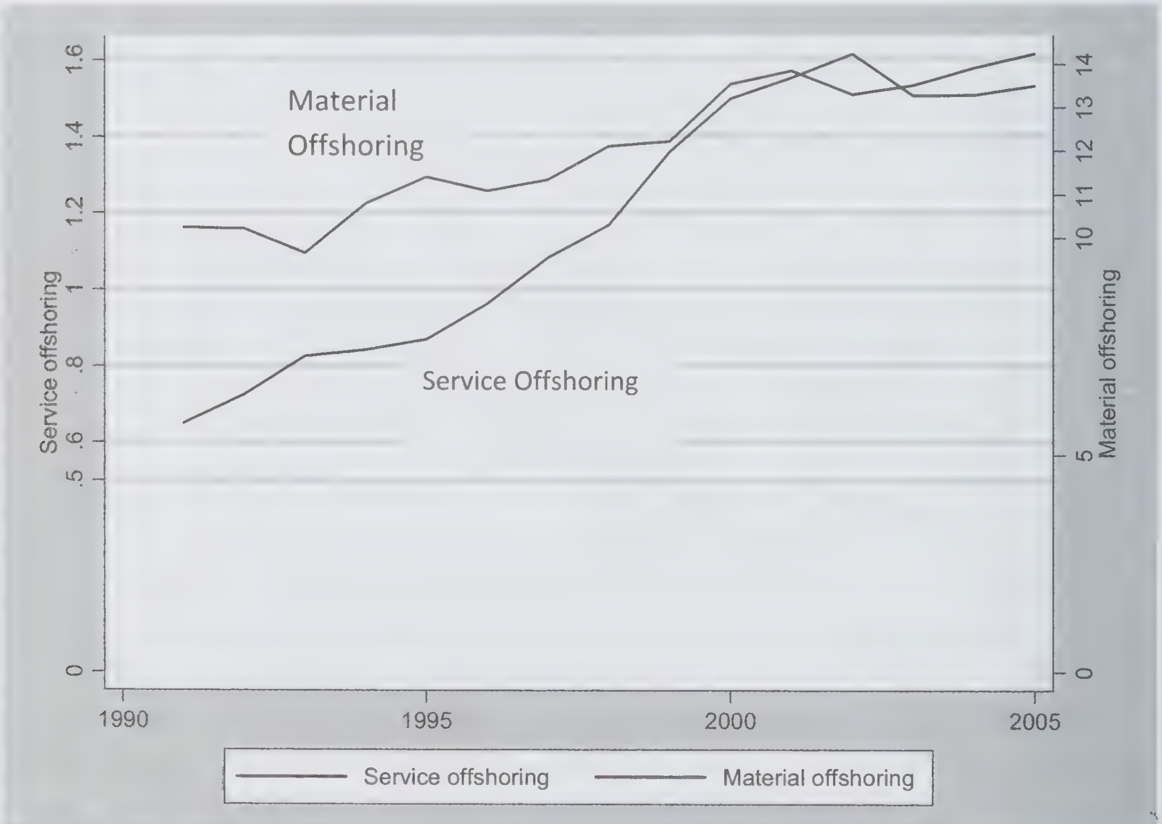
Outward processing trade in the EU, or the Offshore Assembly Program in the US refers to customs arrangements in which complete tariff exemptions or partial levy reductions are granted in accordance to the domestic input content of imported goods. Such information has been used by, for example, Görg (2000) for the EU and Feenstra et al. (2000) for the US. Other related studies rely on the disaggregated classification of trade

statistics to infer whether trade in some particular industry is trade in intermediates or final goods, as for example in the papers by Yeats (2001) and Hummels et al. (2001). Finally, input-output tables in combination with trade statistics have been used by, for example, Feenstra and Hanson (2003), Geishecker and Görg (2008), and Amiti and Wei (2005) to evaluate outsourcing. This measure may be considered the most appropriate because it enables scrutinizing developments across industries and time simultaneously, which is problematic with the mentioned two other measures. Another advantage of using input-output tables is that they allow considering not only material imports but also imports of services which is arguably an important facet of the newer wave of offshoring from industrialised countries.

We use thus input-output tables for Germany to calculate the importance of imports of intermediates relative to total output in an industry across manufacturing sectors in Germany, Based on the approach by Geishecker and Görg (2008), for the period 1991 to 2005.[4]

Figure 2 shows the importance of imported intermediate materials and services inputs for German manufacturing overall. The scale for services outsourcing is on the left and that for materials outsourcing on the right hand side of the graph. Note, firstly, that the absolute level of materials is substantially higher than that of services outsourcing. However, the growth rate of services outsourcing is much stronger. All in all, this figure shows that Global Value Chains appear to be growing in importance for German manufacturing overall.

Figure 2: Imported intermediates relative to output

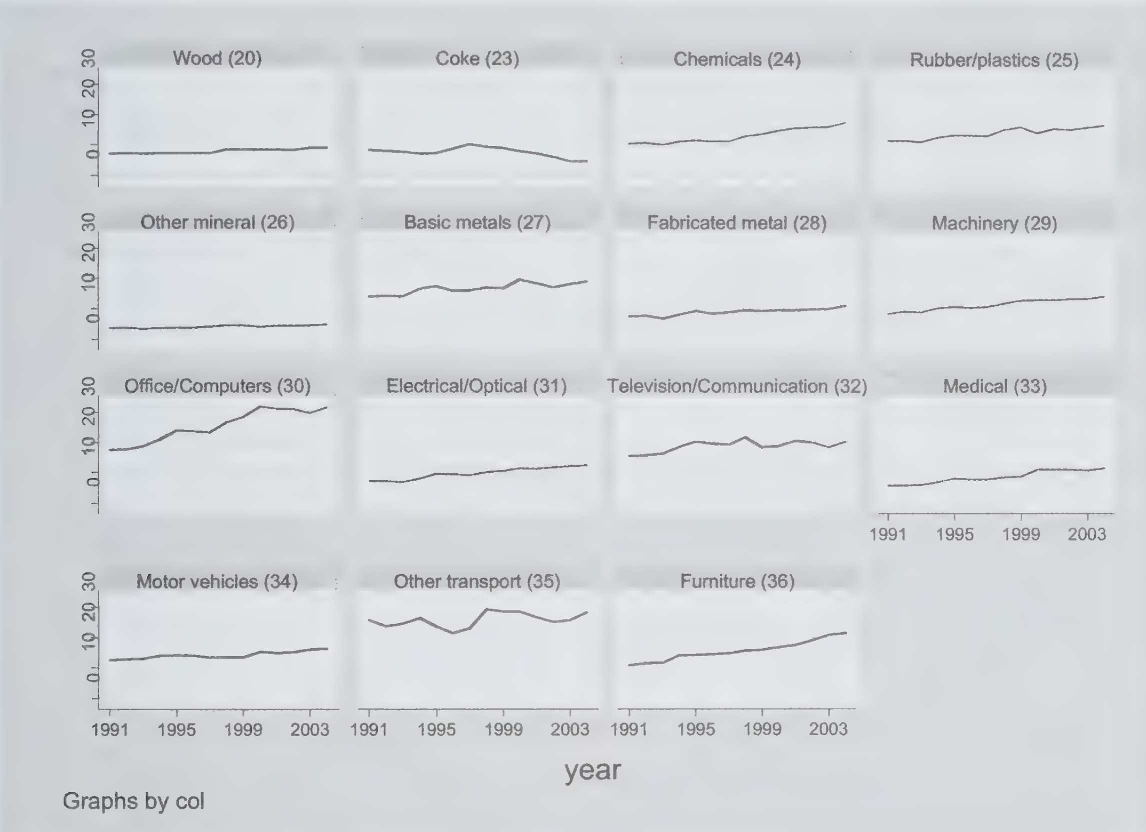


Source own calculations following Geishecker and Görg (2008)

[4] See the appendix for an exact description of the construction of the outsourcing measures.

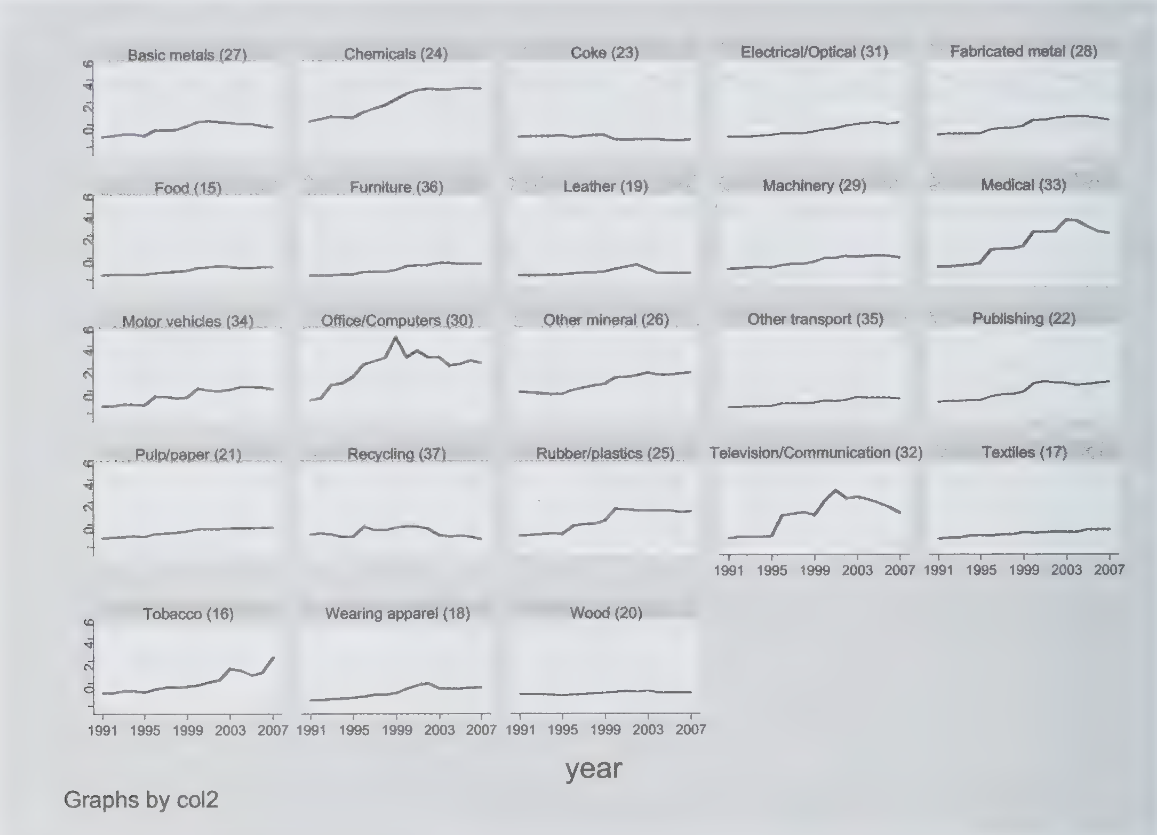
Figures 3 and 4 break down services and materials outsourcing data for different two-digit manufacturing sectors. These two figures show that there is considerable heterogeneity in the importance of imported intermediates across sectors. In particular the "high tech" sectors 30 to 33 show high levels of outsourcing, suggesting that Global Value Chains are particularly important for those manufacturing sectors.

Figure 3: Material outsourcing by two digit industry



Source: own calculations following Geishecker and Görg (2008)

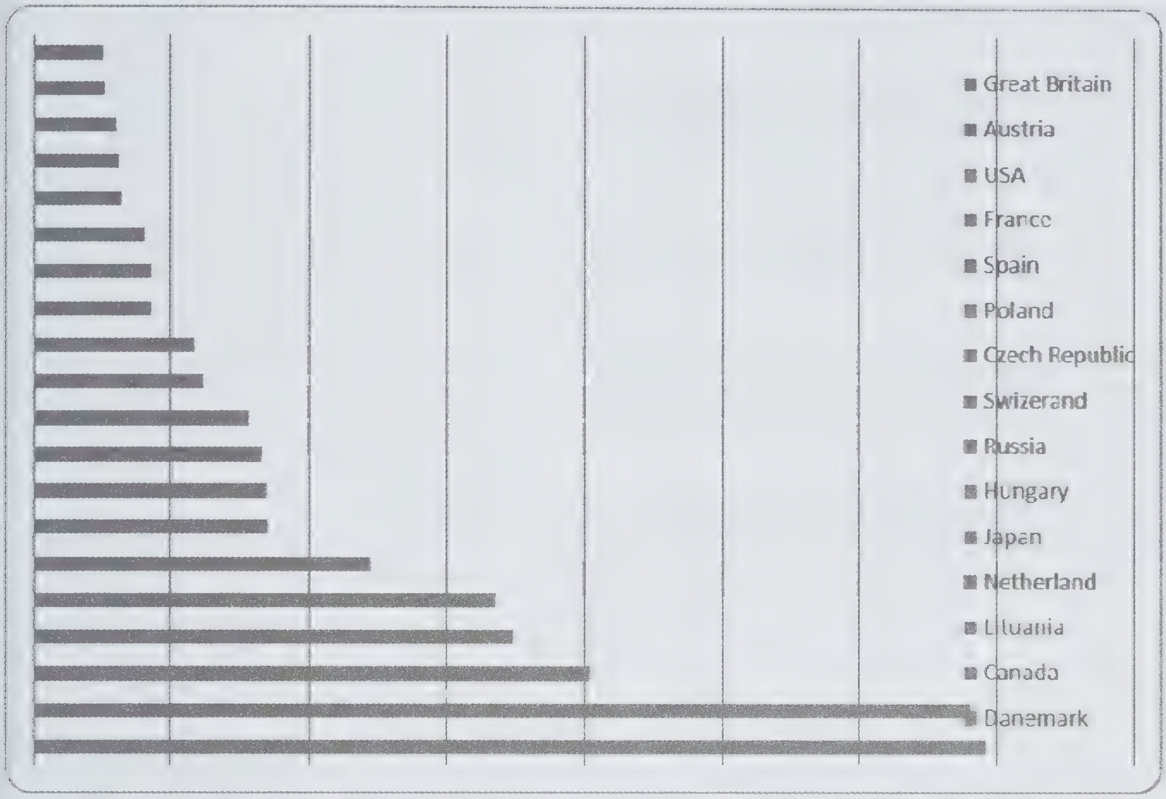
Figure 4: Services outsourcing by two digit industry



Source: own calculations following Geishecker and Görg (2008)

A second possible approach to gauge the importance of GVC is to turn back to the firm level and look explicitly at characteristics of foreign affiliates of German firms. Geishecker et al. (2009) do this for all Euro Area countries. They investigate the location patterns of Euro Area multinationals (not distinguishing nationalities within the EA) and find that most foreign activity is concentrated within the European Union. However, countries like China, Mexico and Brazil have become increasingly important, suggesting some global value chains link Europe to these three countries. We follow their approach but focus exclusively on Germany.

Figure 5: Geographic distribution of German foreign affiliates by destination country (2009)



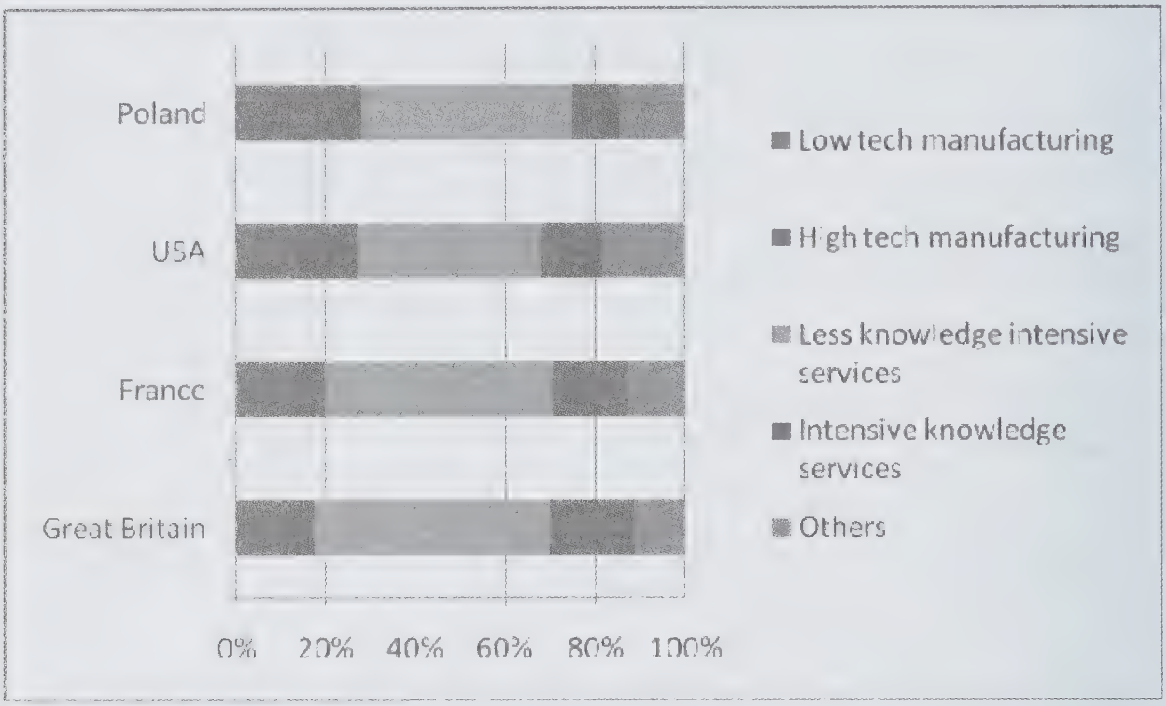
Sources: Bureau van Djik, own calculations. A foreign affiliate is defined by an ownership of at least 10 percent by a German company. Only countries with more than 1 percent of total German affiliates are represented.

Accordingly, Figure 5 looks at the location pattern of foreign affiliates of German parents abroad. Similar to Geishecker at al. (2009) we find that many of the most important locations for German affiliates are within the European Union. For example, the figure shows that the UK and Austria are host to roughly 15 percent of German affiliates abroad each. The US is the third most important host country for German firms, while Canada is number 14, followed closely by Mexico. Hence, NAFTA seems to be an important market for German firms. With China, Brazil and Russia there are also three of the most important emerging markets on the list of top locations for German affiliates abroad which point to the global value chains binding German firms with these countries.

Next, we decompose the primary activities of German foreign affiliates in different countries according to four groups: low-technology manufacturing, high technology manufacturing, less knowledge intensive services and knowledge intensive services suggested by Eurostat. Figure 6 provides a flavour of this break down for four different countries with a large German presence.[5]

[5] Note that for most other countries we do not have adequate information on the activity of German affiliates to disaggregate them according to these four groups.

Figure 6: Location of German foreign affiliates and the type of activities abroad (2009)



Sources: Bureau von Djik, own calculations. A foreign affiliate is defined by an ownership of at least 10 percent by a German company. The definition of the groups is taken from EUROSTAT.

The figure suggests, for example, that Poland looks to be a source of intermediate goods for German firms, as there is a relatively larger share of German affiliates in Poland active in low-tech manufacturing than in the other countries. However, it also appears to be a source of demand for German products, as there is a large share of German affiliates in less knowledge intensive services, which includes wholesale trade and the distribution of products in the foreign market. In the US, by contrast, there is a much higher share of high tech manufacturing firms owned by German parents while in the UK, knowledge intensive services look to take a higher share of German firms when compared to the four other countries. Hence Germany seems to be involved in global value chains with different countries but also with different stages of the production process within each country.

In a last approach to measuring the importance of global value chains for German manufacturing we use firm level information from a recent survey by the German Statistical Office (*Statistisches Bundesamt*). It focuses specifically on firms relocating activities abroad that were previously carried out in-house. This is, thus, a very direct (and perhaps narrow) measure of offshoring, as it considers only production processes that were previously undertaken within the firm. However, this survey provides a rich and unique source of information to better understand the implications of foreign relocation.

Table 6 shows that 16.5 percent of the surveyed firms relocated one or more activities abroad up to 2006. The last column also shows that around 10 percent of firms also plan further relocations abroad in the coming years. The shares of actual and planned relocations are higher in manufacturing, and specifically in technology intensive manufacturing. It is also particularly high in large firms with more than 1000 employees. This suggests that mainly skill and technology intensive larger firms are looking for opportunities to relocate some of their activities abroad.

Table 6: Firms relocating abroad

	Companies	Companies that relocated until 2006	Companies planning to relocate
	Number	%	
Aggregate	19 787	16.5	10.4
Divided in industries			
Mining and quarrying	60	11.7	6.7
Manufacturing industry	9 573	24.5	16.1
Energy- and water-supply	389	5.1	0.0
Construction	861	6.3	5.7
Catering and hotel industry and commerce	4 017	8.5	4.2
Transport and communication	1 195	10.7	4.4
Real Estate business and other services	3 690	9.7	6.2
Divided in technology areas			
Manufacturing industry with intense use of technology	4 029	31.0	21.8
Other manufacturing industries	5 544	19.9	12.0
Knowledge driven industries	1 599	15.4	10.7
Other areas	8 615	7.7	3.9
Divided in employment-size classes			
100 to less than 250	13 486	13.5	8.2
250 to less than 500	4 148	18.4	12.0
500 to less than 1000	1 808	20.6	14.3
1000 to more …	1 270	24.5	15.2

Source: Statistisches Bundesamt (2008), own translation.

Table 7 indicates that firms in the survey employed roughly 8 million employees. Approximately one third of those are, however, employed in firms that already relocated activities up to 2006. Comparing the share of outsourcing based on employees (table 7) to the one based on firms (table 6) provides also an interesting insight. The share based on employees is substantially higher than the share using firm numbers. This again suggests that mainly larger firms are prone to relocating activities abroad. The sectoral pattern depicted in Table 7 is however, very similar to the one shown in table 6.

Table 7: Employment in firms relocating abroad

	Employees	Companies that relocated until 2006	Companies planning to relocate
	Number		%
Aggregate	7 964 478	28.8	17.0
Divided in industries			
Manufacturing industry	4 151 318	38.2	(28.4)
Other manufacturing industries	428 530	(8.9)	(3.6)
Catering and hotel industry and commerce	1 386 802	1.6	(1.0)
Transport and communication	/	/	/
Real Estate business and other services	1 137 924	34.7	1.6
Divided in technology areas			
Manufacturing industry with intense use of technology	2 508 816	(45.5)	(35.8)
Other manufacturing industries	1 642 502	27.1	17.1
Knowledge driven industries	504 376	21.1	11.3
Other areas	3 308 784	/	3.5
Divided in employment-size classes			
100 to less than 250	2 044 650	14.1	8.4
250 to less than 500	1 297 321	20.5	13.3
500 to less than 1000	1 047 468	24.7	16.7
1000 to more …	3 575 039	(41.4)	(23.3)

Source: Statistisches Bundesamt (2008). "/" means that this number is uncertain and thus not disclosed by the Statistical Office.

While table 7 is about the total employment in firms with realized or planned relocations, it does not provide any information on whether or not employees are affected by these relocations through, for example, wage cuts or job losses. This and other consequences of offshoring, are the focus of a later sections and will be discussed after we consider the possible causes for entering into global value chains.

Causes for entering in global value chains

The data in section 3 show that global value chains are an important aspect of German manufacturing, irrespective of the type of measure used. To understand the role of global value chains, then, it is important to understand the driving forces for such involvement in GVCs, or offshoring. To do so, we focus on answering three related questions:

- Why do firms offshore activities that they previously carried out themselves?
- Where do firms offshore their inputs?
- What types of firms offshore?

We firstly discuss these issues in general terms, and then focus on the particular case of Germany.

Why do firms offshore activities that they previously carried out themselves?

As we have seen above, offshoring has increased tremendously over the last decade. Indeed, it is the prevalence of offshoring that, according to a number of observers, make the current wave of globalization unique and different from previous ones.

First of all, it is important to point out that offshoring incurs important costs. The production process (be it manufacturing or services) needs to be split in its components, with some activities migrating to different countries. Doing so incurs substantial new costs of coordination between headquarters and the foreign affiliates, or the independent supplier (Jones and Kierzkowski, 2001). As an example, the following costs may occur:

- Telecommunication between the different partners of a global value chain
- remote management coordination
- maintaining effective quality control
- transportation for intermediate inputs procured abroad
- travel costs for staff
- search costs for finding adequate foreign partners or recruitment costs

This is not an exhaustive list, of course, but gives some idea of what is involved when a firm makes the decision to offshore part of their production process. It is widely recognized that costs of "coordination" have dropped significantly in the last decade or so (e.g., Arndt and Kierzkowski, 2001). There are two important explanations for this recent trend: first, technological progress and second, liberalization in the world trading system. Let us examine these issues in turn.

Technological progress has arguably changed significantly the way international business is structured around the globe. Due to the rise of data dissemination through the internet people can now gather information and order products from firms all over the world. This implies that costs of searching for potential suppliers are now much lower, as are costs for looking for new staff abroad. The related drop in the costs of electronic data transfers, telecommunications and video conferencing means that communication between headquarters and foreign locations is eased and now possible at a fraction of what it cost previously. This has, in turn, also helped management planning, co-ordination, and has facilitated regular quality control.

Another central aspect of technical progress is that many services that were previously non-tradable have now become tradable (e.g., financial services, back office functions, routine business processes etc.) which implies that the production of services can be located anywhere in the world and traded through electronic communication.

In line with technical progress, cost of travel and transportation have also dropped significantly recently, making it now possible for managers or workers to travel easily between headquarters and foreign affiliates when required. Furthermore, trading intermediate inputs through air, rail, sea freight, or roads, central to offshoring is now relatively less costly than it used to be and can be monitored in real time.

Technological advances have gone hand in hand with policy moves to liberalize further the world trading system, making it easier for trade and foreign direct investment to take place. Negotiations starting under the GATT (General Agreement on Tariffs and Trade) and GATS (General Agreement on Trade in Services) culminated in the founding of the World Trade Organisation, liberalizing many aspects of international trade in goods and services (though with significant exceptions). China's accession to the WTO in 2001 arguably was an important step to incorporate China into global value chains.

Furthermore, many governments around the world have successively liberalized restrictions on inward and outward FDI flows, allowing firms to enter countries and set up affiliates abroad. For example, the *UNCTAD World Investment Report 2006* shows that in 2005, 93 countries introduced changes to their regulatory regime towards foreign investment. In total, 205 changes were implemented and 164 of those related to making regulations more favourable towards inward investment, thus contributing to promoting additional global value chains.

Where do firms offshore their inputs?

Having established that global value chains mainly increased because it is now "easier" to do so, the next question is: where do firms offshore their inputs? The short, yet somewhat simplistic answer is, of course, where it is cheapest to do so, taking all the potential costs of offshoring into account. A large economic literature has developed investigating this issue, and we summarize their findings here.

At the very basic level, offshoring takes place because firms aim to minimize production costs. They, therefore, choose locations with the lowest costs for inputs. Frequently highlighted is the role of labour costs in this context. As an example, hourly wage rates for programmers differ widely across the world: Euro 9 in Russia, 14 in China, 7 in India, compared to 44 in the US and 54 in Germany according to Deutsche Bank Research (2004). This goes a long way towards explaining why offshoring of such computer services might be executed in India and China, and no longer in developed countries.

At a more formal level, a number of empirical studies by economists have also confirmed the importance of factor costs for the decision where to offshore. Swenson (2000) investigates econometrically the outsourcing decisions of firms operating in U.S. foreign trade zones, paying particular attention to the relative costs of inputs. She finds in her analysis that firms reduce their reliance on foreign offshored inputs when the relative price of these inputs rises vis-à-vis the US price. More precisely, she finds that a dollar depreciation that leads to foreign inputs (including labour) being more expensive, will cause firms to reduce their outsourcing from abroad.

Furthermore, Hanson et al. (2005) examine the vertical fragmentation of activities around the globe by US multinational firms. They find that US headquarters' demand for intermediate inputs imported from their affiliates abroad is higher when affiliates face lower wages for less skilled workers. This is in line with the hypothesis that production is offshored to affiliates in low cost locations and their output is then used by headquarters as inputs in the US.

Unfortunately, to the best of our knowledge, formal econometric studies focusing on the determinants of services offshoring and the relative importance of labour costs are missing in the literature. However, the anecdotal evidence available strongly suggests that labour costs differences play an important role for the decision as to where to offshore services inputs (Deutsche Bank Research, 2004).

It is important to point out, however, that wages, albeit important, are only one aspect of total labour costs. What matters to a firm is arguably not only the hourly wage a worker receives but the labour cost per unit of production. Hence, the productivity of workers needs also to be taken into account. Omitting such a factor, would overlook the fact that some programming services are still carried out in the US and Germany. In line with this argument, Yeats (2001) shows that the combined effects, of low wages and large

pools of skilled workers have contributed to the attractiveness of Central and Eastern European countries for offshoring activity from EU countries.

While labour and other production costs are important components of total costs of a product, fragmenting stages of production internationally involve also resources in order to trade these inputs across borders. Such resulting trade costs (widely defined as costs of transportation and tariffs/non-tariff barriers) also contribute substantially to overall costs incurred. Notwithstanding the fact that trade costs in general have fallen and thus enabling more offshoring to take place, research has found that these costs can also be important in determining to which locations and in which countries firms offshore activities.

Hanson et al. (2005) in their analysis of fragmentation of production by US multinationals find that the level of costs of trading between the foreign affiliate and the US parent is an important determinant of offshoring activity. Baier and Bergstrand (2000) also show in their analysis that tariff rates and transport costs are important determinants of outsourcing. Specifically, in model simulations they find that a 7.5 percentage point decline in tariff rates combined with a 5 percentage point decrease in transport costs can lead to an increase in vertical specialization (offshoring) by around one-third.

The importance of tariff barriers for offshoring is also highlighted by government policies which provide tariff reductions or exemptions for trade in intermediate goods which are processed abroad and are then shipped back to the home country for final production. As alluded to above, this is known as outward processing trade in the European Union, which is the customs´ arrangement allowing goods to be temporarily exported from EU territory for processing, and the resultant products to be released for free circulation in the EU with total or partial relief from import duties (e.g., Görg, 2000). In the US a similar programme is known as overseas assembly provision (e.g., Swenson, 2004).

Finally, risk is an important determinant of where offshoring activity takes place. This includes issues such as exchange rate risk (Swenson, 2000) but also more broadly defined risks such as political disruptions, corruption, patent protection laws etc. Yeats (2001) provides an empirical analysis which points to the important role played by country risk in determining the location of offshoring activities in the Caribbean region.

What types of firms offshore?

Let us now turn to the question whether, among a random sample of firms we would expect all firms to engage in offshoring or whether it is only a certain group of firms with some specific characteristics that would do so. The answer to this is: only a certain group – and this should consist of the "better" firms in our sample. Not all firms engage into outsourcing.

Recent developments in international trade theory have argued that it is reasonable to assume that offshoring (as any other type of international engagement, such as exporting or foreign direct investment) involves substantial sunk costs. These are irreversible costs that occur due to searching for a foreign partner, setting-up a business partnership, and learning about the possible contractual arrangements, etc. Under this assumption, only very efficient firms will be able to overcome these sunk cost barriers and successfully start to offshore (Antras and Helpman, 2004).

Empirical evidence has been produced which supports this theoretical prediction emphasizing sunk costs. A number of studies look at large samples of firm level data for a number of countries. For example, Tomiura (2005) and Kurz (2006) using data for Japan and the US, respectively, model a firm's decision to outsource and find that more productive firms are more likely to outsource. In particular, Kurz (2006) concludes that

outsourcers are "outstanding" in that they are larger, more capital intensive and more productive. Görg et al. (2008) use firm level data for Ireland to look at differences in productivity between firms that offshore services (i.e., import services inputs from abroad) and firms that do not. They also find that outsourcers are more productive than firms that do not engage in offshoring of services.

From a somewhat different angle, Geishecker et al. (2009) use a large European firm level dataset and investigate the characteristics of firms that trigger the decision to set up affiliates abroad. They find that firms that own affiliates abroad account for an over-proportionally large share of output, employment and profits in their home countries. These firms also exhibit higher survival rates and productivity growth when compared to firms that did not expand abroad.

Thus, theory and evidence strongly suggest that it is indeed the "better" firms, i.e., those that are more productive and larger, that are linked into global value chains through offshoring activities abroad.

Evidence for Germany

For the specific case of Germany, the survey evidence from Statistisches Bundesamt (2008) provides some useful information. In particular, the survey asks firms about their potential motives and possible barriers for relocating activity. These questions are answered by firms that did relocate as well as those that did not. The possible motives are displayed in Table 8.

Table 8: Motives for relocating production abroad

Motive	Companies	Importance				
		Very important	Important	Barely important	Not important	Don't know
	Number	%				
Labour costs	16 649	39.7	42.2	11.2	2.9	4.1
Access to new markets	16 651	45.3	36.5	9.9	4.2	4.1
Other costs	16 649	25.7	48.0	17.8	4.0	4.5
Tax incentives	16 649	17.0	42.0	29.4	7.3	4.3
Strategical target	16 642	21.7	35.8	19.4	17.3	5.8
Less regulation	16 644	15.1	33.4	34.9	11.9	4.7
Implementation of a new business model	16 644	14.5	34.0	31.0	15.1	5.5
Product development	16 647	18.0	29.3	33.2	14.9	4.6
Access to new know-how	16 644	13.7	30.0	33.3	18.5	4.5
Following customers or competitors	16 644	8.8	30.9	38.6	17.0	4.7
Others	524	71.4	26.3	/	/	/

Source: Statistisches Bundesamt (2008), own translation. "/" means that this number is uncertain and thus not disclosed by the Statistical Office.

The table shows that more than 80 percent of firms answered that lowering labour costs and accessing new markets were "important" or "very important" motives for an actual or possible foreign relocation of activity. Other reasons that were rated as important by a majority of firms are other costs and tax incentives. Furthermore, among the least important reason chosen by German firms is "to follow suppliers and competitors" which suggests that a "race to outsourcing" is not a predominant factor that triggers outsourcing decisions by German firms. Notice, finally, that individual firms generally consider multiple reasons simultaneously as important and different firms tend to attach different weights to different motives. This suggests that firms´ decisions as to whether to start outsourcing or not are also strongly driven by firm specific intrinsic factors. There are no "one fits all" motives of outsourcing for all firms. They vary across firms and time, which may be difficult to pick up in specific surveys or econometric analysis.

Table 9 looks at another dimension of the location decision by asking firms (both those that did and did not relocate) what the possible barriers (actual or perceived) to such relocations are. Here, roughly two-thirds of firms rank language and cultural barriers, or other legal and administrative barrier as most relevant or highly relevant parameters that hinder relocation decisions. Furthermore, labour regulations, tax issues, distance to the foreign location and general cost-benefit concerns are important issues that play a role in firms´ decision process to relocate production abroad

Table 9: Barriers to relocating production abroad

Barrier	Companies	Importance				
		Very important	Important	Barely important	Not important	Don't Know
	number	%				
Language and cultural barriers	16 631	27.4	43.2	19.0	6.5	3.9
Other legal and administrative barriers	16 631	13.0	49.9	26.6	6.2	4.2
Cost-benefit ratio	16 630	20.1	38.8	25.2	11.2	4.6
Distance to production facilities	16 628	19.5	36.5	27.6	12.2	4.3
Fiscal issues	16 631	11.7	41.5	34.9	7.7	4.1
Interests of employees	16 628	10.3	42.1	32.9	10.5	4.3
Business ethics problems	16 628	7.9	42.1	34.5	10.7	4.8
Uncertainty about international standards	16 631	9.3	40.4	36.0	10.0	4.3
Risk of patent infringement	16 631	16.0	32.9	32.5	14.5	4.2

Barrier	Companies	Importance				
		Very important	Important	Barely important	Not important	Don't Know
	number	%				
Distance to core markets	16 630	16.2	32.1	33.2	14.2	4.3
Tariffs	16 631	10.6	36.5	34.7	14.1	4.2
No suitable suppliers abroad	16 628	11.2	32.5	34.9	17.0	4.5
Insufficient process documentation	16 626	5.5	25.4	43.9	20.3	4.8
Other	254	64.2	31.7	0.0	/	/

Source: Statistisches Bundesamt (2008), own translation. "/" means that this number is uncertain and thus not disclosed by the Statistical Office.

One frequently voiced perception is that German firms took advantage of the emergence of close by and low-wage Central and Eastern European (CEE) countries by outsourcing most of their inputs in these countries. Such an argument clearly deserves some attention. To assess this, we can relate to evidence by Geishecker (2007) who uses calculations similar to those reported in Figure 2, but where he is able to break down outsourcing by partner country. He finds that outsourcing to CEE countries is at a relatively low level for Germany. In 2004 it accounts for about 13 percent of total imported intermediate inputs; the bulk of outsourcing (almost three-quarters) is with other developed countries. Still, outsourcing to CEEC has by far the highest growth rates, between 1995 and 2004 it roughly doubled in size.

Another indication to illustrate the attractiveness of German firms to Eastern European Countries´ products and services is suggested in Table 10 which is taken from the survey by the German Statistical Office. It shows the relocation destinations of German firms according to 9 broad regions including one on the neighbouring new member states of the European Union. We observe that most German firms in the sample relocated some activities in these new EU member states, but among these firms, the majority (54 percent) relocated some activities in at least another broad region beside the new EU member states. This suggests that new European Union member states are attractive to German firms, but that relocating activities there is also often part of a broader strategy as to where to outsource their activities.[6]

[6] An interesting further question is whether Germany's geographical location aids it in attracting other firms to locate in Germany. For example, all else being equal, a manufacturer that uses intensively inputs from low wage countries could locate in Germany, rather than say France to be closer to suppliers in low-wage Eastern Europe. As far as we are aware there is no evidence to judge whether or not this is happening to any large extent

Table 10: Geographic relocation of German firms by broad regions

	Total	To multiple regions
	%	
Germany	38,6	-
EU-15	27,6	32,5
New EU member states	59,3	54,2
Rest of Europe	19,1	24,0
China	33,7	43,2
India	16,4	23,6
Australia and Oceania	11,5	15,0
North America	14,9	21,1
Latin America	7,5	11,2
Africa	3,8	5,2
Firms relocating (Number)	3 261	2 123

Source: Statistisches Bundesamt (2008), own translation.

As such, this suggests that proximity, low trade costs, an educated workforce, and lower wages than in Germany are not the sole factors that drive the decision about outsourcing activities in its eastern close by countries. Factor costs and productivity considerations as well as firm-level characteristics shown in section 4.2 are also included in the choice of an optimal outsourcing strategy for German firms.

Additional studies that focus specifically on German outsourcing to CEEC are informative too. Marin (2006) defines outsourcing as any foreign direct investment (FDI) that also involves intra-firm trade between the parent and its foreign affiliates. She finds that almost half of German FDI in CEEC fulfils this condition and therefore is categorized as outsourcing. In particular, she shows that outsourcing dominates German FDI in the Czech Republic, Bulgaria, Slovakia and Romania, but is less important in Slovenia and Poland.

Marin (2006) and Marin et al. (2002) also investigate what may drive the German outsourcing decisions to CEEC. Low labour costs are, of course, important, as is the proximity between Germany and these countries, which presumably allows relatively easy relocations of activities and minimised trade costs. Furthermore, reduced levels of corruption and improvements in the contracting environment in CEEC are found to affect positively German outsourcing to these countries. There is no evidence that tax holidays granted by host countries play any role, however.

We now turn to the question of "which German firms outsource". The survey of the German Statistical Office does, unfortunately, not provide any information on the characteristics of firms involved in global value chains. However, we can use some alternative data on German firms to those used so far. The database we use is part of the "Business Environment and Enterprise Performance Survey" (BEEPS) which is carried out jointly by the World Bank and the European Bank for Reconstruction and Development. While this firm-level business survey focuses on transition countries in Eastern Europe and Central Asia, a comparison survey of firms in a number of more developed countries, including Germany, was also carried out in 2004.[7]

[7] A more detailed description of this data base is available at http://www.ebrd.org/pages/research/analysis/surveys/beeps.shtml, accessed on 6 July 2010.

These data permit to look at some microeconomic characteristics of offshoring firms given that the database includes information on firms´ imported intermediate inputs, which we use as a measure "offshoring". Specifically, we calculate offshoring as the percentage of imported material inputs in total supplies, and alternatively as the proportion of imported inputs to total sales. Using information on the roughly 1,100 manufacturing firms available and based in Germany, we run regressions of the form:

$$\ln(\text{labour productivity})_i = \beta_1 \text{ offshoring}_i + \beta_2 \ln(\text{size}_i) + \varepsilon_i$$

where the dependent variable is labour productivity in firm *i*, calculated as sales per worker, and the variable *size* is measured in terms of employment in order to control for size differences across manufacturing firms.

The regression results are reported in Table 11. They show that firms´ offshoring activity, measured in terms of imported intermediate inputs, is positively and statistically significantly correlated with labour productivity, even when controlling for firm size. These results are, thus, in line with the above reported international evidence by Kurz (2006), Tomiura (2005) and Görg et al. (2008) and indicate that more productive firms are more likely to be intensively engaged in global value chains.

Table 11: Regressions on productivity and offshoring

	(1)	(2)
Imported inputs / total Inputs	0.005***	--
Imported inputs / sales	--	0.011***
Size	0.087**	0.078**

Table reports coefficient estimates from OLS regression. Dependent variable is log labour productivity. Regression also includes a constant, which is not reported. *** and ** denote statistical significance at 1 and 5 percent level, respectively.
Source: Own calculations based on BEEPS firm level data for Germany for the year 2004.

Consequences of global value chains

This section discusses the evidence on the implications of relocation activity / GVCs for German manufacturing firms and considers also their employment decisions. Here we will focus on productivity / competition / technology effects for firms, and labour market outcomes (employment levels, relative demand for skills and wages) for workers, relying on survey evidence and the existing relevant literature for Germany (e.g., Wagner 2009, Geishecker, 2009, Geishecker and Görg, 2008, Winkler, 2009).

As a first step, the survey evidence provided by the German Statistical Office can be used to gauge some of these effects. Table 12 shows that 85 percent of firms replied that the relocation contributed to improved their overall competitiveness. Three quarters of firms also indicated that it had positive implications for their labour costs, i.e., reduced labour costs in line with the expectations. These two facts can be interpreted together with a more formal econometric study of the effects of outsourcing on firm performance by Görg and Hanley (2010), based on Irish micro data. They argue that firms engage in outsourcing in order to locate some of their "non-core" labour intensive production stages abroad. This enables them to reduce labour costs for production at home, and use the increased profit to enhance their competitiveness through R&D and innovation. Their empirical analysis based on a large sample of Irish firms not only confirm this theoretical mechanism, but also might help

explain why enhancing competitiveness and reducing labour costs found in table 10 are seen as an important effects of offshoring for German firms.

Table 12: Effects on firms with relocations

	Effect			
	Negative	neutral	Positive	Not specified
Aspect			%	
Competitiveness	/	7.9	84.6	9.9
Cost of labour	(1.2)	13.0	77.4	8.4
Access to new markets	(1.2)	21.0	59.3	18.6
Other costs	4.1	31.6	56.4	8.0
Own know-how	7.9	48.5	22.8	20.7
Access to new knowledge	5.2	47.0	13.0	34.8
Logistic	16.8	35.4	24.5	23.3
Product development	6.7	40.0	11.1	42.3
Other aspects	(0.5)	0.0	2.4	97.0

Source: Statistisches Bundesamt (2008), own translation. "/" means that this number is uncertain and thus not disclosed by the Statistical Office. "(…)" means that the number is not as accurate.

As for possible labour market effects, Table 13 indicates that firms view the relocation of employment as important, irrespective of the skill levels of the employees. However, the skill levels of workers are important for the creation of new jobs in firms that offshore. Indeed, two thirds of firms did not create any new jobs for low skilled workers. By contrast, almost half of the firms indicate that they created new high skilled jobs.

Table 13: Employment effects in firms with relocations

		Employment effects		
Employment effects by skill level		applies	Does not apply	Not specified
		In … % of the enterprises		
Relocation of employees…	In low skill occupations	61.8	25.0	13.1
	In high skill occupations	62.1	27.2	10.7
Employment creation…	In low skill occupations	15.1	65.6	19.3
	In high skill occupations	46.4	38.4	15.2

Source: Statistisches Bundesamt (2008), own translation.

Table 14 provides even more detailed evidence on job creation and job destruction in firms that relocated activities abroad. Overall, 188,600 jobs were destroyed in Germany, while 105,500 were generated as a result of firm relocations. Hence, the ratio of jobs created to jobs destroyed is 56 percent overall. The picture is however much more positive for high skilled workers. 63,300 lost jobs are balanced by 59,300 newly created positions, yielding a ratio of 94 percent. The table also shows that this pattern in favour of skill

intensive jobs is particularly pronounced in high tech manufacturing and knowledge intensive services industries.

Hence, low skilled workers are apparently the group that incur most losses due to relocations of activities abroad. In absolute terms, more low skilled jobs are relocated abroad, and substantially fewer new jobs for workers with such a level of qualifications are generated at home.

Table 14: Job creation and destruction due to relocations

	Employment at the old location				Created/relocated	
	Relocated		Created			
	Aggregate	Skilled	Aggregate	Skilled	Aggregate	Skilled
	Number				%	
Economy overall	188600	63300	105500	59300	55.9	93.7
Divided into technology areas						
Manufacturing industry with intense use of technology	91500	30500	46500	28700	50.9	93.9
Other manufacturing industries	45300	11500	22500	8300	49.7	72.2
Knowledge-driven services	23700	7300	18000	8800	75.9	120.5
Other areas	28200	13900	18500	13500	65.5	97.1
Divided into employment-size classes						
100 to less than 255	73000	21700	33600	18400	45.5	83.4
250 to less than 500	38300	(13700)	22800	9400	58.8	(67.7)
500 to less than 1000	28900	(8900)	(19600)	(10800)	(66.9)	119.9
1000 and more…	(48400)	(19100)	(29500)	(20600)	(60.2)	106.3
Divided into group membership						
Headquarters	(54300)	(20700)	(38100)	(24800)	(69.4)	(117.3)
Part of business group with headquarters in Germany	32000	9800	(24500)	(11800)	(32.7)	(54.8)
Part of business group with headquarters abroad	65900	(21200)	(21800)	(11800)	(32.7)	(54.8)
Independent Enterprise	36100	11500	20800	11700	57.1	99.9

Source: Statistisches Bundesamt (2008), own translation.

Of course, the survey answers provide only a subjective assessment of the actual situation on net job changes in Germany. This may be particularly problematic when it comes to isolate and assess the effects per se of linking into global value chains. Fortunately, more systematic research, using the mentioned survey data linked to official firm census data, is undertaken by Wagner (2009). He uses these combined data to estimate the actual employment effects due specifically to firms´ relocations abroad, using a propensity score matching approach. This empirical approach permits to compare very

similar firms which differ only because some outsource abroad while other comparable, *matched* firms do not. He finds, firstly, that, in line with the literature surveyed above, firms that relocated activities tend to be larger and more productive before their relocation takes place compared to other firms that never relocated activities abroad. Secondly and more importantly concerning the employment effect resulting from relocations abroad, he finds that there are no statistically discernible effects on employment from the relocation decision.

A similar question is addressed by Bachmann and Braun (2010) and Geishecker (2008), but from another perspective using large samples of data on individual workers. They estimate whether offshoring (measured in terms of imported inputs constructed with input-output tables) has any noticeable effect on workers' movement into unemployment or/and into non-participation in the labour market. Both papers use different datasets but apply similar methodologies which nevertheless lead to slightly different results. While Geishecker (2008) finds that offshoring significantly increases the risk of becoming unemployed, Bachmann and Braun (2010) find for workers in the manufacturing industry that only the risk of moving out of the labour force is affected, but not the risk of moving into unemployment. Both studies, however, find that their main effects do not differ strongly among skill groups. The jury is, thus, still out on judging the possible effects of offshoring on employment when using such worker-level data.

In related research, a number of studies have also tried to estimate the possible effects of international outsourcing on wages. Here, Geishecker (2006) and Winkler (2009) investigate how outsourcing affects the relative wage of skilled and unskilled workers using industry level data. Their main findings are in line with the international literature (e.g., Feenstra and Hanson, 2003; Hijzen et al., 2005): outsourcing indeed raises the relative wage of skilled workers. Geishecker (2006) finds that in particular outsourcing to Central and Eastern European Countries has contributed to increase the skill intensity of German production at home, in line with the idea that low skill intensive activities are more likely to be relocated to (low wage) Central and Eastern European Countries.

More recent studies dig deeper into the relationship between outsourcing and wages using worker level data with even more precise information on workers' employment profiles and activities. Here, Geishecker and Görg (2008) find that a one percentage point increase in outsourcing reduced the wage for workers in the lowest skill categories by up to 1.5 percent while it increased wages for high-skilled workers by up to 2.6 percent. These results are statistically significant, but economically small (mirroring those found for the US in Liu and Trefler, 2008).

Baumgarten et al. (2009) expand on this analysis by adding to the picture the tasks workers carry out in addition to information on workers' skill levels. They rely on a different estimation approach and thus find economically much stronger effects of outsourcing on workers. For example, their estimations suggest that low-skilled workers that carry out mainly non-interactive tasks that can be easily outsourced (c.f. Blinder, 2006) experience cumulated wage cuts of 8.85 percent per hour (equivalent to 1.31 euros). For low-skilled workers with medium degrees of interactive tasks, the cumulated wage cut is 0.77 euros while low-skilled workers with the highest degree of interactive tasks only experience wage cuts of 0.29 euros. An additional important finding is that there are no discernible wage effects for high skilled workers, irrespective of the tasks they carry out.

To sum up, recent empirical evidence suggests that relocating production abroad does have some implications for firms and workers, as one would expect, but that the magnitude of these effects appears to be far less adverse, than is generally expected.

Possible future development

This section will briefly consider the question as to what may be the likely future development of Global value chains with a particular attention to the future of services offshoring.

Recent work by Blinder (2006) and van Welsum and Reif (2006) argue that a growing number of jobs in the service sector have the characteristics to be offshored if not now, then very soon.[8] Given that the service sector employs most workers in developed countries, and that technological progress combined with reduced barriers to international trade and investment allows a wider range of jobs to be done remotely, they suggest that a wide range of jobs could be under threat, depending on the specific task or occupation the workers carry out. The possibility to offshore numerous jobs does not mean, however that firms are necessarily going to adjust to this new strategic possibility. Table 6 shows clearly that only 10.4 percent of all firms interviewed in the survey plan to outsource in the future. This low number deserves attention.

Why are not more firms planning to outsource? First, most firms that never outsourced are unlikely to be able to support the costs involved in engaging in global value chains. This would be in line with the survey findings that there is no "race to outsourcing" because of costs of searching for partners, planning and coordinating the sourcing of inputs from abroad. These costs hamper their possibility to outsource. However, no race to outsourcing would also be consistent with firms struggling or failing in their outsourcing experience.

Indeed, the survey evidence present in table 12 shows that at least 13 percent of outsourcing experiences did not contribute to any labour cost reduction. If firms were planning to reduce their labour costs than such a result suggests that firms did not achieve their objectives. Another facet of unanticipated costs is also presented in Table 12. It shows that numerous firms (16.8 percent) had negative experiences with logistics costs. This suggests that a wide range of hidden costs are linked to outsourcing.

On this issue, an additional insight is provided by a study on outsourcing decisions of German firms by Kampker (2009). He calculates total production cost savings of firms relocating activities abroad, including all costs such as labour and logistics costs already mentioned.[9] The results show that most firms realized only minor savings, if any. More striking is the fact that truly successful outsourcers (saving more than 20 percent in costs compared to the initial situation) are the exception, rather than the rule. If their findings can be generalized, then they partially explain why "following competitors" is not an important parameter among the motives to outsource: gains from outsourcing might not contribute extensively to a competitive advantage for all firms. Competitors without outsourcing activities are thus not forced, in turn, to engage in global value chains.

We may now consider firms that had already an experience with outsourcing. These firms overcame the sunk costs and integrated their foreign sourcing of inputs to their traditional activities. This does not mean that all firms were successful with their foreign engagement. Indeed, as shown in table 15, 4 percent of German firms surveyed plan to make a U-turn or to pull out partially from sourcing goods abroad.

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[8] Similar analyses for Germany are presented in Schrader and Laaser (2009).

[9] Note that the survey is very detailed about the cost structure before and after relocation and thus has been undertaken on a rather small sample of 54 German firms in 3 industries with 77 foreign plants openings during a span of 5 years.

Table 15: Future plans about relocation abroad

Outsourcing firms	Expand further	Unchanged	Partial or complete withdrawal	Decision Dictated by group strategy
Number	%			
3106	53.3	36.1	4.0	6.7

Source: Statistisches Bundesamt (2008), own translation.

Even if this is a minority of cases, some firms are at least pushed to optimize their outsourcing strategies. For example, BMW had to halt part of its automobile production in Germany during the volcanic ash cloud interruption in spring 2010, as supplies from foreign sources were not forthcoming due to restrictions on air transport.[10] Similarly, Boing recently reconsidered its global outsourcing strategy because of coordination problems resulting in important delays for their 787 "Dreamliner" airplane.[11] It is difficult to isolate the most important factors that lead to problems and result in failure, but it suggests that offshoring does not warrant "success" for all firms.[12]

As for the motives for outsourcing, firm and time characteristics might be important, but the recognition of possible failure is rather understudied and not well documented yet in the case of outsourcing. The risk of failure is likely to be taken into account, when the decision to engage in global value chains is set.

Concerning firms that have been successful in their outsourcing strategy, two scenarios might be proposed (e.g., Kampker, 2009). First, those firms may optimize their outsourcing activities, by relocating among their foreign activities and locations. This might be the result of relative labour costs changes between foreign locations, or new risks, that firms want to circumvent. Another possibility, one that has attracted much attention recently is that successful experiences with partners abroad lead firms to deepen their relationship and to reward their partners with new orders, but this time with more skill intensive activities. This would be in line with a so called second stage of outsourcing, where presence abroad permits to firms to build upon a first stage experience, assess the strength and potentials of their foreign partners and locations and finally outsource more skill intensive parts of their activities.

There is clearly a need for more research on the role of global value chains. In particular, cross country analysis and the recent wave of services outsourcing are central to a better understanding of global value chains. It could benefit from interactions between policy makers, business and academic practitioners.

Overall, the impression from academic research on German data is global value chains, offshoring and relocations are clearly important for German manufacturing

[10] See „BMW to Halt Three German Plants Because of Ash Cloud" at http://www.businessweek.com/news/2010-04-20/bmw-to-halt-production-at-three-german-plants-due-to-ash-cloud.html, accessed on 7 July 2010.

[11] See "Boeing to Rein in Dreamliner Outsourcing" at http://www.businessweek.com/bwdaily/dnflash/content/jan2009/db20090116_971202.htm?campaign_id=rss_daily, accessed on 7 July 2010.

[12] Table 15 also shows that among the firms that already relocated abroad, only 53 percent planned some further relocation. This has to be contrasted with table 6 where 10,4 percent of the whole sample of firms are planning a future relocation.

industries. Policy makers should be skeptical about claims of pervasive and large adverse effects resulting from global value chains in Germany. While, as expected, some negative effects appear for some groups of workers in empirical evidence; those are far less adverse than generally claimed in public discussions. Also, losers could be supported through appropriate policy measures, which need to be seriously debated. A sensible approach for policy is to make sure that global value chains are not hampered in order to ensure that competitiveness and overall benefits of global value chains are fully exploited.

Conclusions and Summary

This paper examined the role of global value chains in German manufacturing. Global value chains have clearly expanded in recent years and while the bulk of outsourcing continues to be materials outsourcing, services outsourcing is growing and catching up quickly. Not all German firms participate in global value chains but, there is strong evidence that those that do are among the most efficient in Germany.

Close by Central and Eastern European countries and new European Union member states are attractive locations for German firms, and not only for low wage manufacturing activities. However, the value generated in these countries and flowing to German firms is still small, albeit growing rapidly compared to other European Union members. Furthermore, these countries seem often to be chosen in an overall global value chain strategy which includes other more distant locations.

Among more distant trading partners, China has not only become an important source of many inputs but also a large customer of German exports of products and services and which accounted for about 5 percent of total German exports in 2009. The reasoning for this follows that of traditional comparative advantages and patterns of specialization; China demands goods like capital-intensive and research-intensive machinery and equipment in which Germany has a comparative advantage.

There is evidence that workers in Germany are indeed affected by outsourcing decisions by German firms. However, empirical research does not support net employment destruction following relocation decisions of firms. Instead, German firms adjust and specialize into more skill intensive activities which demand relatively more skilled workers. Another related finding is that some wage decrease is observed among workers employed in activities prone to be outsourced. It appears however that the magnitude of this is economically small and far from the popular myth of disruptive consequences of global value chains for employment and wages.

More recent empirical research shows economic benefits for German firms from their involvements in global value chains. Reductions in total factor costs induced by increased outsourcing of goods and services permit firms to achieve gains in production efficiency and competitiveness.

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Appendix

Calculation of outsourcing measures (imported intermediate inputs) in Figures 2 - 4

This definition is based on Geishecker (2006).

International Outsourcing is measured as the value of an industry's imported intermediate inputs from industries abroad as a share of the domestic industries output. In order to allocate imports according to their use as inputs across industries we employ input-outpu tables for Germany. This enables us to observe the share of imports from an industry abroad that is used by the domestic industry in a given period (denoted *k* in the equation below).

Formally, outsourcing in domestic industry *j* in year *t* is defined as

$$OUT_{jt} = \sum (IMP_{jt} * k_{jt}) / Y_{jt}$$

where *IMP* are imports, *k* is the proportion of imports used by the domestic industry, and *Y* is industry output. By differentiating imports by the origin while assuming k to be constant across countries one can construct offshoring measures for different geographic regions.

Data come from Eurostat trade statistics, German Input output tables and the OECD STAN database.

The Nordic Model and the Challenge from Global Value Chains

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Are the Nordic countries winning or losing the globalization game?

Global dispersion of value chains

With the increasing ease of communication and transportation, the falling costs of processing and transferring information, and the major political and societal changes that have occurred in recent years, the link between economies of scale and the geographic concentration of production has weakened. It has become feasible and profitable to disperse global value chains in time and space at a fine level of aggregation. This trade-in-tasks (Grossman and Rossi-Hansberg, 2008) or second unbundling (Baldwin, 2006; 2009) is among the most important features of modern globalization.

Basic economic theory suggest that deepening specialization brings about aggregate benefits. As agents and institutions involved do not necessarily/fully redistribute these benefits, there are bound to be both winners and losers. Therefore, current high-income countries are justly concerned about the sustainability of their prevailing standards of living.

The Nordic model

The Nordic countries are widely recognized as a group that has been able to combine efficiency and equity to meet the challenges imposed by globalization (Andersen et al., 2007; Sapir, 2006). Nordic countries differ in many respects but also share common features that make up a social and economic system that may be referred to as the "Nordic model".

The principal features of this model include the following: consensus-driven decision making, collective bargaining and strong labor market institutions, extensive transfers to households and publicly provided social services financed through taxes, and high public investment in education and research. The essence of the Nordic model is a combination of collective risk sharing and international openness (Andersen et al., 2007).

Sapir (2006) identifies four types of socioeconomic models in Europe – the Continental model, the Mediterranean model, the Anglo-Saxon model, and the Nordic model (Figure 1.1). He then compares the ability of the models to bring about efficiency and equity in society using various indicators of social justice, income distribution, employment protection, economic growth and stability, and living standards. While there is often a trade-off between equity and efficiency, he argues that the Nordic countries have been able to achieve both.

Figure 1.1. The Four European Models: A Typology

		EFFICIENCY: Low	EFFICIENCY: High
EQUITY	High	Continentals	Nordics
	Low	Mediterraneans	Anglo-Saxons

Source: Sapir (2006).

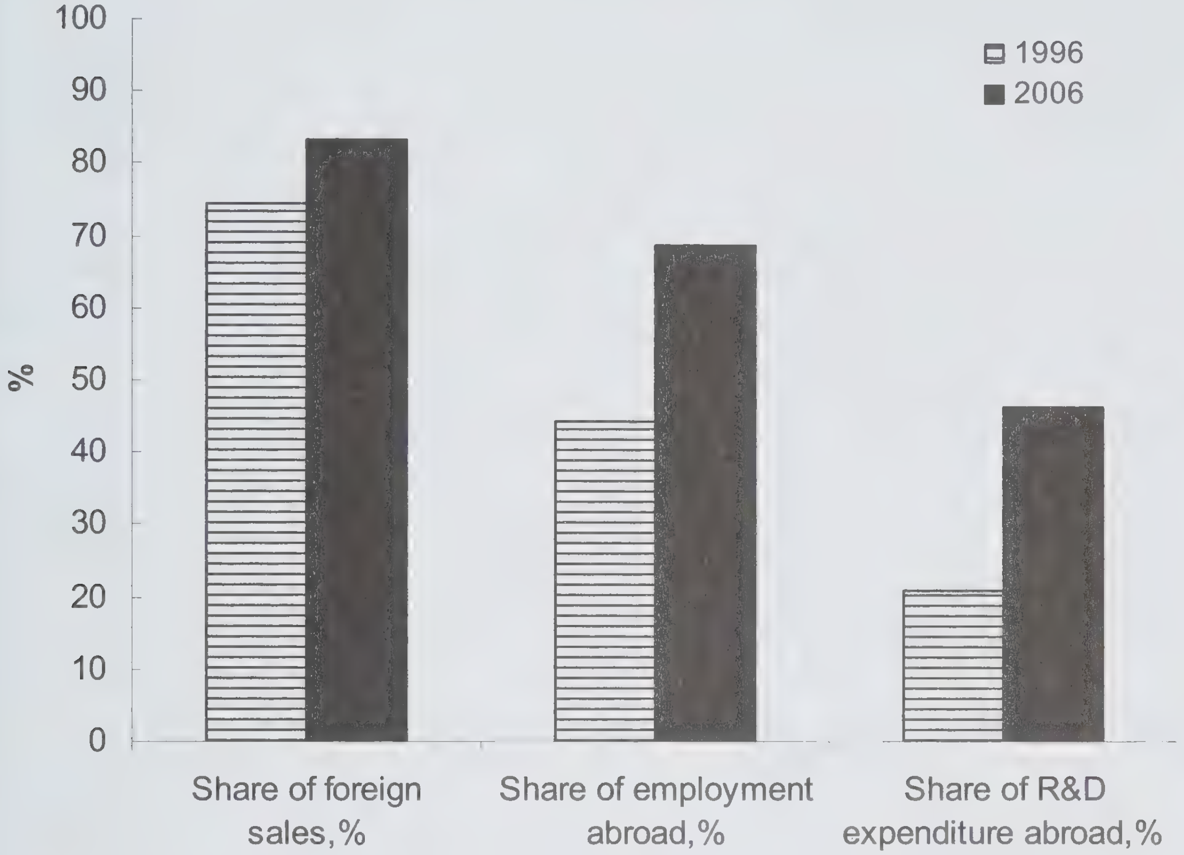
Indeed, the Nordic economies have been performing well in terms of export and GDP growth, external balances, and public finances (Andersen et al., 2007). They were hit hard by the global economic crisis, but they are recovering faster than Europe as a whole and especially faster than Southern European countries, many of which continue to face major imbalances and structural weaknesses.

The offshoring challenge

Past achievements aside, the long-term sustainability of the Nordic model is in doubt. Multinational enterprises' search for the most cost-effective location of each business activity is eroding the Nordic countries' manufacturing bases and weakening the traditionally densely networked industrial clusters. Especially in Finland, which has a large high-wage manufacturing sector, this is clearly an issue of concern. Furthermore, national clustering is arguably a feature that promotes solidarity among labor market participants and private citizens.

Having a highly internationalized business sector has been an integral part of the Nordic model for decades; the largest corporations in the region currently derive their revenue primarily from international operations (Braunerhjelm et al., 2010). The internationalization of business has been exceptionally fast in the past few decades, as illustrated by the Finnish case (Figure 1.2). This internationalization has also been qualitatively different from earlier times: internationalization has concerned not only production jobs but also high-value-added "supportive" tasks such as research and development (R&D). Earlier internationalization has often translated into increasing exports by expanding domestic production; in the current mode, internationalization often means choosing globally optimal locations for ever-finer slices of the value chain. With the increase of this type of internationalization, large corporations are detaching themselves from their original home countries and national institutions.

Figure 1.2. Role of overseas operations in the 30 largest manufacturing companies in Finland



Source: The authors' calculations.

Outsourcing, offshoring, and technical changes have led to a polarization of the labor markets in developed countries. The shares of managers and professionals and also personal service workers tend to grow at the expense of manufacturing and routine office jobs (Goos, Manning, & Salomons, 2009). Mid-range jobs are hit the hardest by the current phase of globalization.

Policy responses

In the public debate, it is recognized that offshoring and the global dispersion of value chains are challenges for small open economies. Consequently, all Nordic countries have high-level groups or councils that consider the opportunities and threats of and policy responses to globalization. Finland has been particularly active in this respect (Baldwin, 2006; Ottaviano & Pinelli, 2004; Secretariat of the Economic Council, 2004, 2006a, 2006b), closely followed by the other countries. On 12 April 2005, Denmark set up a special globalization council chaired by the country's prime minister; Sweden has a similar council (www.sweden.gov.se/sb/d/9299). With respect to globalization, all Nordic countries have come to the same conclusion: one should *not* resort to policies that attempt to curb globalization but rather should implement reforms improving knowledge- and productivity-based national competitiveness; the Nordic countries should embrace deepening international specialization rather than fight it.

What is at stake?

At least one key aspect of the Nordic socioeconomic model, that is, the labor market institutions and related wage formation mechanisms, is undergoing a major change: collective bargaining arguably becomes less desirable and less feasible when the locus of competition shifts from the industry and firm levels to the level of individual job assignments. This shift may also more generally weaken solidarity among inhabitants. Will this and other changes erode the Nordic model, or can these countries continue to achieve "the best of both worlds"?

In what follows, we consider of the motivations for and the extent of value chain dispersion. The Nordic countries are discussed as a group, although we primarily use Finland as an illustrative example. In the concluding section, we consider the sustainability of the Nordic model in light of the presented evidence.

The Nordic countries as participants in global value chains

The business sectors in the Nordic countries have exceptionally high ratios of foreign to domestic employment. In this respect, Denmark ranks at the top. Danish companies employ 1.48 million people abroad, which is equivalent to 52% of their domestic

Box 1. *Nokia* in the Finnish Economy

Nokia is the most important single company in the Finnish national economy. Some 30% of its (including Nokia Siemens Networks) global R&D personnel is currently in Finland. In 2009, *Nokia* accounted for more than one-third of the total R&D and one-half of business-enterprise R&D performed in Finland. Its share of the country's GDP was nevertheless "only" 1.6% (Box 1 Table 1).

Box 1 Table 1. The role of Nokia's domestic activities in the Finnish national economy

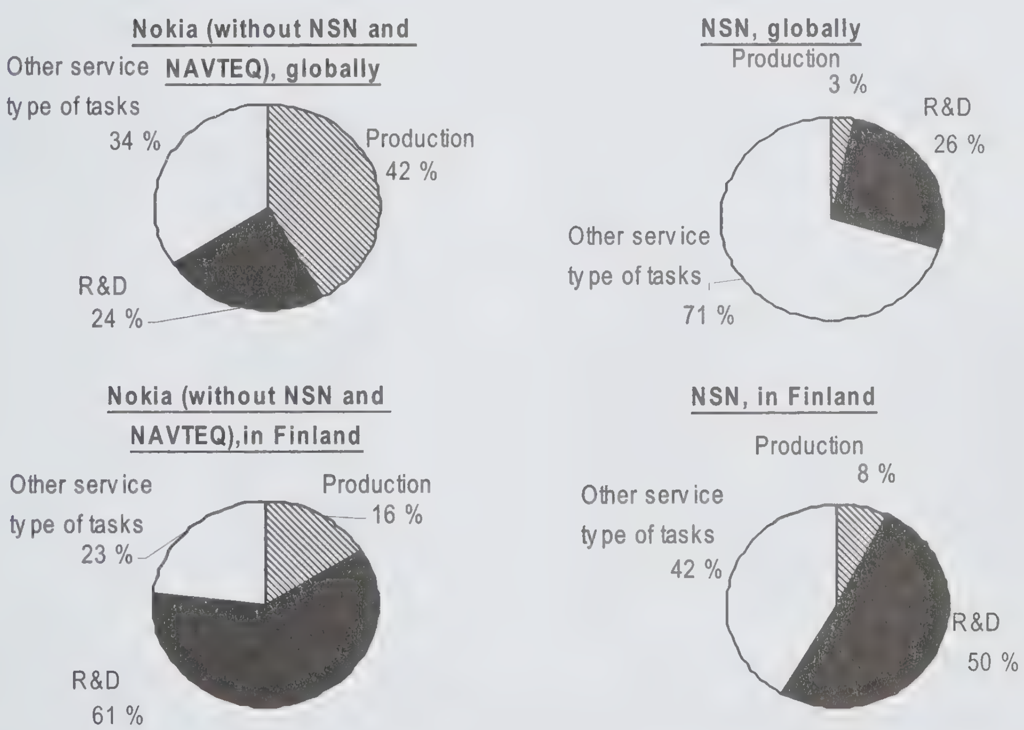
	Nokia
Share of GDP	2.6% in 2008 (1.6% in 2009)
Contribution to GDP growth	2.13 percentage points in 2000 (the peak year) -0.11 percentage points in 2008 -0.88 percentage points in 2009
Share of total employment	0.9% in 2009
Share of manufacturing employment	5.5% in 2009
Share of total R&D exp. (GERD)	37.6% in 2009
Share of business sector R&D exp. (BERD)	51.2% in 2009
Share of patents (EPO patent applications)	43% in 2006
Share of corporate taxes	21.7 percent in 2003 (the peak year) 7.1% in 2008 2.6% in 2009
Share of manufacturing value added	11.5 % in 2008

Source: Ali-Yrkkö (2010)
Notes : GERD, Gross domestic expenditure on R&D; BERD, Business Enterprise Research and Development; EPO, European Patent Office.

Nokia's supplier network in Finland has drastically changed in the 2000s (Seppälä, 2010). Finnish manufacturing suppliers have lost most of their positions to competitors. Some of these firms were acquired by Asian companies that sought new technological competencies and/or new customers. The Finnish suppliers that remain have offshored their manufacturing operations (e.g., *Salcomp*). In non-manufacturing tasks, such as those in software development, *Nokia* continues to have an extensive subcontractor and partner network in Finland.

Even if *Nokia* is still classified as a manufacturing company by Statistics Finland, only a minority of its employees works in "pure" production (Box 1 Figure 2): in the parent company (*Nokia* without *Nokia Siemens Networks* (NSN) and *Navteq*, its US-based digital maps and navigation arm), roughly 40% of employees work directly in production. In NSN, the corresponding share is only 3% (SEC, 2008). Whereas NSN has a significant number of employees in delivery execution, logistics, global procurement, and other tasks related to manufacturing, the great majority of employees are working on R&D, sales and marketing, and other service types of tasks. The figure also illustrates the central role the Finland has in Nokia's global R&D.

Box 1. Figure 2. The employment of Nokia and NSN by tasks (2008) globally and in Finland



employment. For Finland and Sweden, the corresponding figures are 19% and 25%, respectively.[1] In addition to resulting from openness of these countries, these high shares are attributable to the high employment shares of larger companies (Braunerhjelm et al., 2010).

[1] Sources: Statistics Finland, Statistics Sweden, and Statistics Denmark; the authors' calculations.

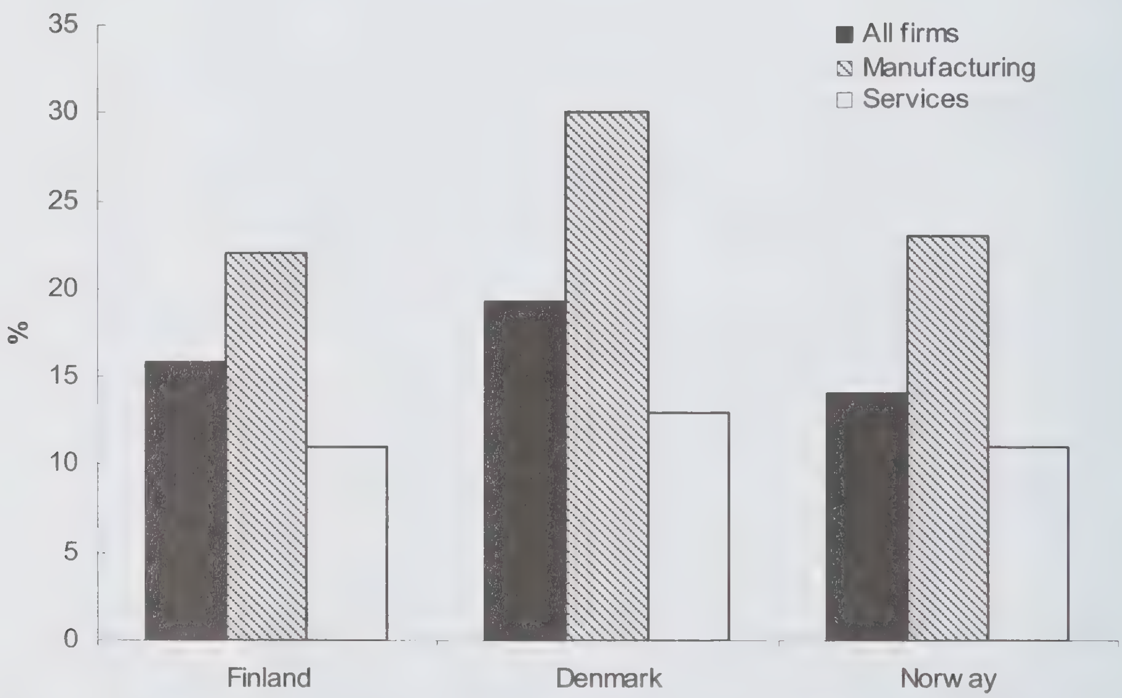
The extent of outsourcing and offshoring

In August 2003, one of the world's top manufacturers of mobile phone chargers, *Salcomp Oy*, announced that it would relocate its production from Finland to China. This news marked the beginning of the current phase of globalization for Finland.

Although it was feared otherwise immediately following Salcomp's announcement, offshoring has remained relatively modest in Finland: in 2000-2006, some two thousand jobs were relocated annually (Ali-Yrkkö, 2006a, 2006b); relative to the total employment of roughly two million, this rate is modest.

In 2001-2006, roughly one-fifth of manufacturing and one-tenth of service firms with 50 or more employees in Finland engaged in offshoring (Figure 2.1). Within these broad sectors, firms in high-tech manufacturing or knowledge-intensive business services (KIBS) were more likely to engage in offshoring (Ali-Yrkkö and Rikama 2008). Therefore, it does not seem to be true that the knowledge-intensity of the industry would in itself be a sufficient condition for insulating domestic employment from the adverse effects of globalization.

Figure 2.1. Shares of companies with 50 of more employees in the country that engaged in offshoring in 2001-2006, %



Source: Statistics Denmark (2008). Original Eurostat-coordinated surveys conducted by Statistics Finland, Statistics Denmark, and Statistics Norway (Alajääskö, 2009).

Although labor cost savings represent the main motive to offshore (Table 2.1), it is by no means the only one. Sometimes the decision to offshore is beyond national control, that is, it has been made at a higher (non-national) level of a multinational conglomerate's hierarchy. Indeed, for the Nordic countries, with the exception of Denmark, decision making at a higher-than-national level is a motive of roughly equal importance. Finnish companies have been especially motivated by the desire to follow their key customers or mimic their competitors, which may be explained by the presence of a few "locomotive"

companies (Kauppalehti 12.8.2010, Seppälä 2010).[2]

Table 2.1. Motives of offshoring

	Finland	Denmark	Norway	Sweden
Reduction of labor costs	42%	59%	43%	58%
Reduction of costs other than labor costs	21%	39%	29%	29%
Access to new markets	23%	11%	18%	10%
Following the behavior/example of competitors/clients	30%	4%	8%	..
Improved quality or introduction of new products	7%	9%	9%	..
Strategic decisions taken by the group head	42%	24%	51%	59%
Focus on core business	18%	21%	18%	18%
Access to specialized knowledge/technologies	11%	13%	12%	12%
Tax or other financial incentives	2%	2%	4%	..

Note: Share of firms having sourced internationally in 2001-2006 and reporting "very important" for the motivation factor concerned.

Source: Statistics Denmark, p. 54

As the result of the motives not related to labor cost, the old EU member states (EU-15) have been the most frequent offshoring destination of Finnish firms (Table 2.2), closely followed by the new EU member states (EU-12).[3] Not surprisingly, manufacturing firms in particular have offshored to China. Additionally, India and Russia have attracted Finnish manufacturing firms.

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[2] According to Braunerhjelm et al. (2010), the largest manufacturing firms are more dominant in Finland than they are in the other Nordic countries. In 2009, the 10 largest exporters accounted for 37% of the total merchandise exports of Finland (National Board of Customs 2010).

[3] The old Member States: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

The new member states: Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia, the Slovak Republic, Bulgaria and Romania.

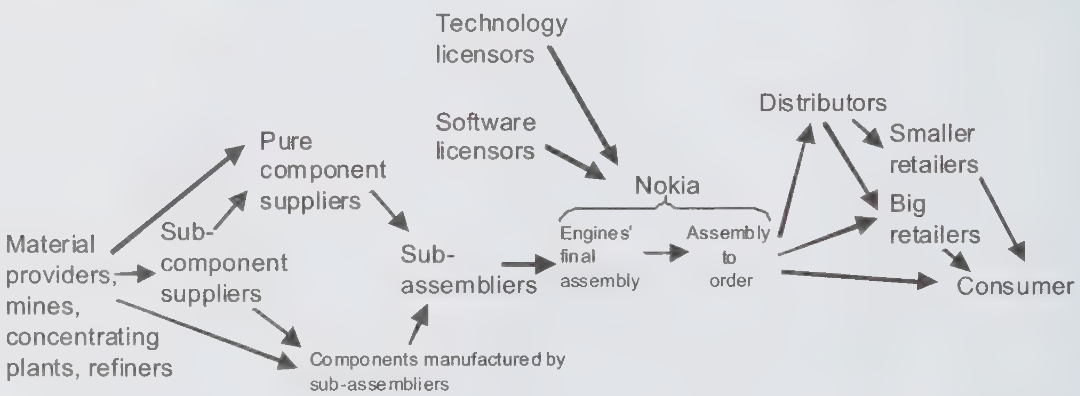
Table 2.2. Shares of companies with 50 of more employees in Finland that offshored in 2001-2006

	All sectors (all functions)	Manufacturing (all functions)	Services (all functions)
Old EU member states	52%	48%	58%
New EU member states	50%	53%	45%
Russia	10%	12%	8%
Other Europe	8%	9%	7%
China	19%	27%	7%
India	15%	13%	17%
The US or Canada	8%	9%	6%
Other countries	10%	10%	9%

Data source: Statistics Finland

Box 2. Global Value Chain of Mobile Phones – Case Study of the Nokia N95 smartphone
(based on Ali-Yrkkö 2010 and Ali-Yrkkö, Rouvinen, Seppälä & Ylä-Anttila 2010, forthcoming)

The Nokia N95 smartphone consists of some 600 tangible components and a range of intangible components and other inputs. We studied the phone's global value chain from the extraction of metals and minerals to the final delivery to the phone's end-user (Box 2 Figure 1).



The value chain is geographically dispersed: the processors of the N95 were provided by Nokia's long-time ally Texas Instruments (US). The display and the most expensive memory chips came from Samsung (South Korea). On the semiconductor side, the main European companies that contributed were NXP Semiconductor (the Netherlands), STMicroelectronics (Switzerland) and Cambridge Silicon Radio (the UK). The AC adapter is made by Astec, which is headquartered in the US with manufacturing in China. On the software side, the operating system was provided by Symbian (UK). Application software included RealPlayer and Adobe Acrobat, both of which are produced by US companies. Nokia assembled the N95 in its own plants in Finland and in China.

In 2007, the pre-tax retail price of N95 was $749 in the US. This is the total value added to the product, which was created in different phases by a large number of firms located in

various countries on several continents. Out of this value, Nokia captured 50%, first-tier hardware vendors captured 11%, first-tier intangible vendors captured 3%, second- and subsequent-tier vendors-of-vendors in both categories captured 19%, wholesalers captured 3.5%, and retailers captured 11%. Therefore, Nokia captured most of the value added, which went to paying Nokia's indirect and direct in-house labor costs such as assembly, R&D, marketing, and sourcing but also includes its "pure" profit.

From the national economy's point of view, it is more important to consider the geographic breakdown of the total value added than to consider the companies. Even if virtually all hardware components are manufactured outside Finland, approximately 38% of N95's total value added is created domestically if the country of final sale is abroad. If the handset is sold in Finland, then roughly half (55%) of the total value added is created domestically. Taking into account both locations of final assembly and markets being served globally, over the life cycle of the product, on average, 40% of the value added was captured in Finland.

As in the case of Finland, the old EU member states have been the most frequent offshoring destination for Norway, whereas for Sweden, the most prevalent offshoring region has been the new EU member states. The most frequent destination of Danish companies has, however, been Asia (Statistics Denmark, p. 26).

Böckerman and Riihimäki (2009) examined the employment effects of offshoring using linked employer-employee data for the period 1999-2004.[4] Their estimates indicate that intensive outsourcing (more than twice the two-digit industry median) neither reduces employment nor has an adverse effect on low-skilled workers. Hakkala and Huttunen (2010) used the same data to examine the effects on home-country employment. They found that offshoring is associated with an increase in the share of home-country tasks that are non-routine or interactive. Furthermore, offshoring to a low-income country increases the risk of job loss for workers in routine and non-interactive occupations.

R&D internationalization and offshoring

Overseas operations not only include production tasks but also include R&D. Finnish manufacturing firms currently employ 26,000 R&D employees abroad (EK 2010), which approaches their domestic R&D employment of 27,000 (Statistics Finland 2009). The number of overseas R&D employees has risen significantly over the past 15 years; in 1997, Finnish companies had only 3,300 R&D employees abroad (TT 1999). The largest firms have played a significant role in this development not only in Finland but also in Sweden and in Denmark (Braunerhjelm et al., 2010).

The rising number of overseas R&D employees does not necessarily mean that those jobs have been relocated; foreign units may do tasks that were never done domestically or may be expanding indigenously. Therefore, offshoring and foreign expansion are not synonymous.

Some 15% of companies with 50 or more employees in Finland have offshored R&D tasks (Table 3.2). In manufacturing, the top destinations are China, the old EU member

[4] In this study, the definition of offshoring is based on firms' use of imported intermediate inputs.

states, and the new EU member states. In services, the old EU member states are followed by Russia and the new EU member states.

Table 3.2. Shares of companies with 50 of more employees in Finland that have offshored R&D tasks in 2001-2006

	EU-15	EU-12	Russia	China	India	The US or Canada
All sectors (R&D)	37%	25%	15%	23%	17%	7%
Manufacturing (R&D)	30%	30%	0%	37%	22%	17%
Services (R&D)	42%	21%	26%	13%	14%	0%

Data source: Statistics Finland

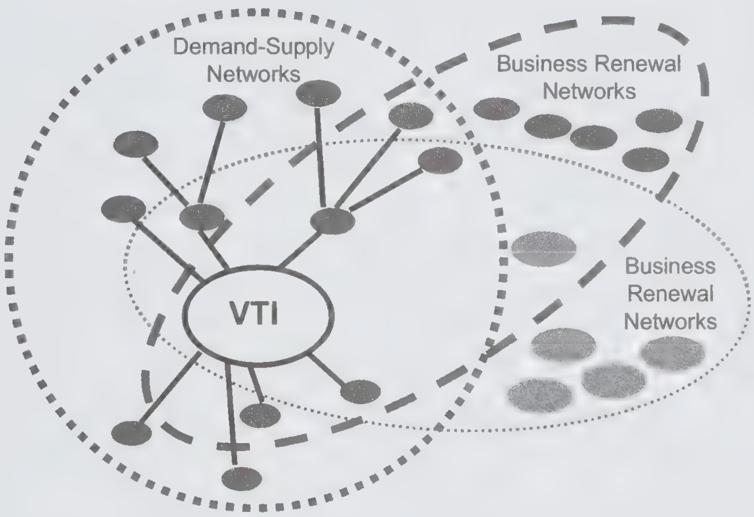
The offshoring of R&D has primarily been driven by the desire to enter a new market, to better fulfill customer needs, and to achieve cost savings (Ali-Yrkkö 2006a). Local regulations and needs often necessitate making product adjustments, and the easiest way to implement these adjustments may be by having a local presence. Operating in developing countries often generates cost savings because, for instance, in China, the cost of R&D staff is approximately one-third or one-fourth of the cost of equivalent labor in Finland (Ali-Yrkkö and Tahvanainen 2009). However, some R&D tasks have also been offshored to developed countries such as the US, where R&D labor costs are notably higher than in Finland. Based on qualitative data covering the largest Finnish companies, Ali-Yrkkö and Palmberg (2008) report that in Finland the labor costs of R&D are, on average, less than half of the US level and in most cases are clearly lower than in Germany or in Sweden.

Box 3. Global Value Chain of Sensors – Case Study of *VTI Technologies Oy*

VTI Technologies designs and manufactures sensors for a number of industries, e.g., automotive, consumer electronics, and medical equipments. In 2008, the company manufactured its products in Finland, Mexico, and China, but in 2009, the company decided to move its Mexican operations to Finland.

Following Möller & Rajala (2007), the value networks of VTI can be classified into three categories (See Box 3 Figure 1): current business nets (including current demand-supply nets), business renewal nets, and emerging new business nets. These nets are partly overlapping. For instance, some suppliers in VTI's current supply chain networks also belong to its business renewal networks.

Box 3. Figure 1. The Classification of VTI's Value Networks



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The business renewal networks of VTI consist of companies, universities, and research institutes. The majority of cooperating universities and research institutes are located in Finland but some are located in the other EU-15 countries. The R&D cooperation related to integrated circuits is conducted with the same companies that currently deliver chips to VTI; consequently, the vast majority of these partners are located in the US and in Germany.

The emerging new business nets consist of organizations that participate in long-term research and development. VTI has a number of research projects targeting commercialization over the next 5 to 12 years. One example of a long-term project is the development of next-generation electric cars that utilize nanotechnology. The project consortium consists of more than 30 organizations in 10 European countries. Out of these organizations, 19 are companies, and the rest are universities and research institutes. Three companies participating in the project also belong to VTI's current demand-supply network.

During the past 15 years, the structure of VTI's demand-supply network has changed drastically. On the one hand, VTI has successfully expanded to new customer segments, e.g., in the medical equipments industry. On the other hand, although VTI's primary customers remain headquartered in Western Europe and the US, their manufacturing sites are increasingly located in low-cost countries; therefore, VTI delivers its products to these locations.

The supply networks of VTI have also changed. To reduce its dependency on sole suppliers, the company has sought secondary ones. Currently, roughly two-thirds of VTI's components and raw materials are sourced abroad (in value terms); the majority of inputs, which include integrated circuits and packages, are still sourced from the old EU members (EU-15) and the US.

During the past 10 years, the main change in VTI's value chain has been related to the geographic destination of its deliveries. In the consumer electronics segment in particular, customers are still primarily European and American companies, but now these companies have plants in China and other low-cost countries. Therefore, VTI's exports in the consumer electronics and in the automotive segments are increasingly sent to developing rather than to developed countries.

Source: Ali-Yrkkö (2009).

Does offshoring replace domestic R&D? Ali-Yrkkö and Deschryvere (2008) find that the impact of foreign R&D employment on domestic employment depends on the mode of internationalization. Moreover, manufacturing and services differ in this respect. In the manufacturing sector, the in-house *offshoring* of R&D in particular has a significant negative impact on the plan to increase domestic R&D employment. However, the relationship between the in-house *expansion* of R&D abroad and domestic R&D employment turns out to be complementary. In the service sector, it is primarily offshore *outsourcing* of R&D that has a significant negative impact on the plan to increase domestic R&D employment.

In 2008, Finnish firms had 3,600-3,800 R&D employees in China, accounting for almost 15% of the Finnish firms' R&D employment abroad (Ali-Yrkkö & Tahvanainen 2008). The study by Ali-Yrkkö and Tahvanainen (2009) showed that there have been three main motivations for R&D investment of Finnish firms to China: 1) market size and

growth, 2) the availability and labor costs of R&D personnel, and 3) the need for co-location between R&D and manufacturing. However, locating R&D in China also has disadvantages, which include intellectual property rights violations and information leakages. A further disadvantage is the lack of employee initiative, which is related to the high level of respect of hierarchies that is found in China.

Ali-Yrkkö and Tahvanainen (2009) conclude that, in the future, the domestic R&D activities of Finnish firms will increasingly emphasize longer-term technology development and other more challenging or "conceptual" R&D activities. More routine R&D will be increasingly conducted abroad in lower cost locations.

Conclusions and policy discussion

In the 1980s and early 1990s, all of the Nordic countries lifted the remaining restrictions on cross-border capital flows and liberalized their financial markets. Although all of these countries experienced banking crises and other "growing pains" as a consequence, at least up until the early 2000s, they clearly benefitted from this policy. Because these countries seem to fare quite well also in the current trade-in-tasks era, their commitment to openness and deepening international specialization will most likely be sustained.

Although offshoring has increased rapidly in the Nordic countries, it remains relatively modest in both absolute and relative terms. At least some local employment has successfully shifted toward higher-value-added activities in global value chains, as routine tasks have migrated to locations with lower labor costs. As far as dealing with the current phase of globalization is concerned, the Nordic countries have done better than most other European countries.

High-level globalization groups or councils in the Nordic countries have concluded that the most appropriate way to deal with the challenges imposed by globalization is to invest in education and innovative activity and to promote a vibrant corporate sector. Mutual trust and collective risk sharing have made globalization both more acceptable and more tolerable to citizens.

Although the Nordic model was perhaps more appropriate for the old trade-in-goods or export-driven phase of globalization, the core aspects of the system can also be maintained in the trade-in-tasks era. The main building blocks of the model – high investment in human capital, skills, and research as well as exposure to market competition – are sustainable. It may well be that the system's biggest challenge is an internal one: as the locus of competitions shifts toward the level of the individual, the appreciation for communality – the very core of the model – may change in the longer run.

Partly as a response to globalization, labor market institutions have undergone major changes in all Nordic countries over the past few decades. Centralized wage bargaining has been replaced by union-level agreements combined with firm-level arrangements.

An essential feature of the Nordic model is the extensive provision of public welfare services funded through taxes and employer/employee contributions. Therefore, businesses' indirect labor costs are high in international comparison, and these high indirect labor costs – along with intensifying international tax competition – has made it difficult for Nordic businesses to compete, particularly in labor-intensive tasks.

Leading Nordic firms have been able to specialize in high-value-added activities in global value chains, while assembly and some other activities are increasingly offshored to developing countries. However, these companies are few in number, and the high-level professionals, experts, and managers they largely employ in their home countries represent

a minor share of the total national employment. There seems to be persistent unemployment among *mid-level* manufacturing workers and *routine office* employees. Additionally, the previously secure higher-level positions are increasingly challenged.

Currently, the Nordic model provides little incentive for self-employment and entrepreneurship. In particular, the number of growth-seeking younger firms is quite small in all Nordic countries (particularly in Finland), which at least partly is an outcome of the existing socioeconomic model with ambitious egalitarian values. Certainly, one of the reforms needed is to create better conditions for high-growth entrepreneurial firms. This is all the more important, as the domestic operations of large multinationals have been constantly diminished in all Nordic countries.

Because it is becoming harder to increase tax revenues in the post-crisis globalized world, it is also evident that there is a need to define the core activities of the public sector and to give more room for private service provision. This would not, however, imply giving up the essential principles of the Nordic model.

Overall, the increasing globalization of business, the unbundling of production processes, and the growth of trade-in-tasks are not necessarily undermining the essence of the Nordic socioeconomic model, even if they call for reforming parts of it.

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Appendix

Data description

This study primarily used two data sources. The first one was a survey conducted by Etlatieto Ltd. (Ali-Yrkkö 2006a). This survey focused on the extent and motives of outsourcing and offshoring in 2001-2006. The sample consisted of 1,827 companies, of which 1,650 could be reached. Of these, 653 (40%) responded. The respondents represented the companies' top management.

The second source was a survey conducted by Statistics Finland in 2007 (Ali-Yrkkö & Rikama 2008, Statistics Denmark 2008). Representatives of more than 1,300 companies responded to the survey (in the group of large companies, the response rate was 83%; in the group of small companies, the rate was 75%). Similar surveys were also conducted in Denmark, Sweden, Norway, and in some other European countries. Instead of offshoring, the questionnaire used the term "international sourcing," which was defined as follows: *"The total or partial movement of business functions (core or support business functions) currently performed in-house or domestically outsourced by the resident enterprise to either non-affiliated (external suppliers) or affiliated enterprisers located abroad".*

Both surveys included a set of direct questions focusing on offshoring/ outsourcing motives and their results/impacts.